VOL. XII. Nº 5 MAY 1927

MECCANO MAGAZINE

SUGAR FROM TREES
(see page 386)

6D

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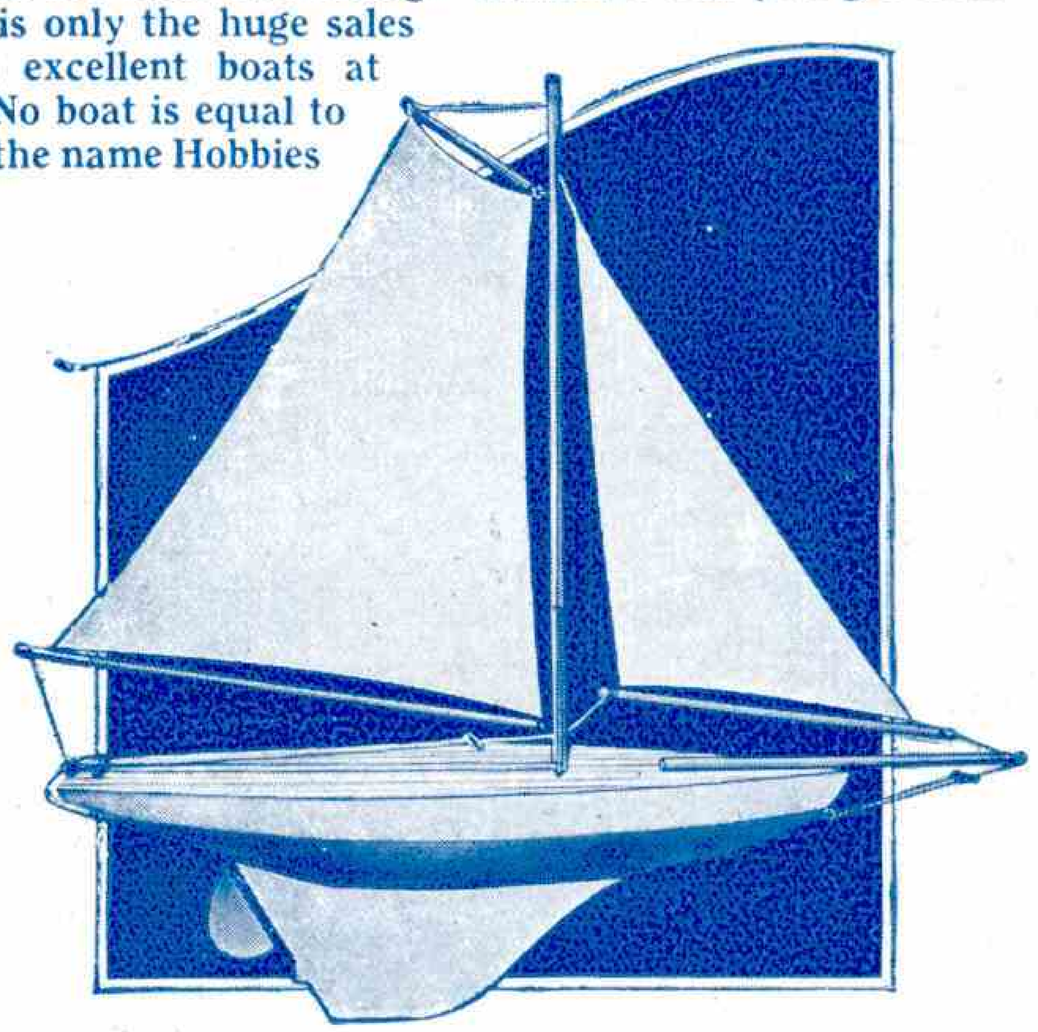

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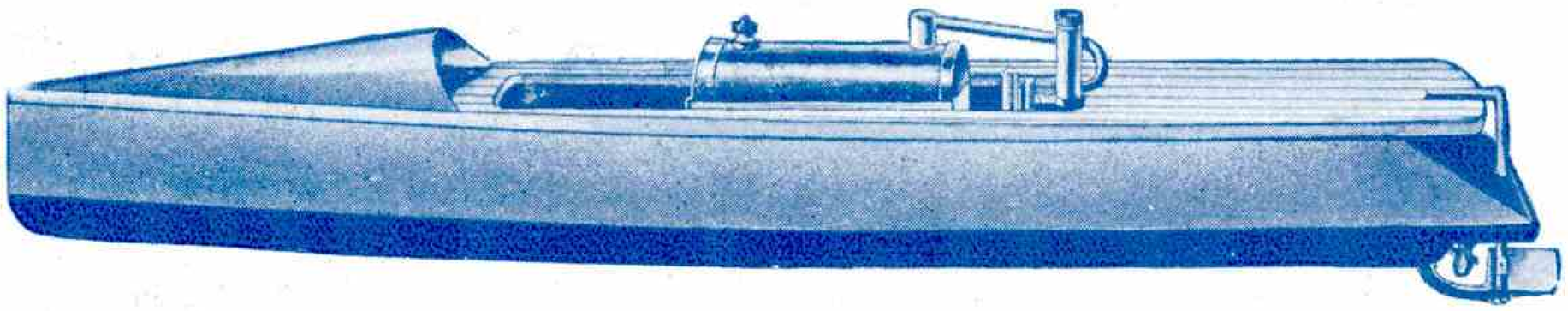

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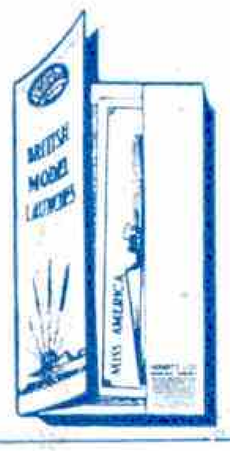

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With the Editor

Recording High Speeds

On this page last month I made some mention of the speed record set up by Captain Malcolm Campbell on his Napier-Campbell car, fitted with a 500 h.p. Napier Lion aero-engine. This record has, of course since been beaten by Major Segrave on his 1,000 h.p. Sunbeam—an achievement that is described on page 392 in this issue.

Captain Malcolm Campbell's speed was 174.224 miles an hour, and I mentioned that the Editor of the "*Engineer*" cast doubts on the accuracy of the time of 20.663 seconds. He based his remarks on the statement that no stop watch could give accuracy to three decimal points, because the ordinary five-second stop watch has a balance wheel that makes five oscillations a second, and therefore the position of the seconds hand has no significance except at the exact fifth second marks.

It now transpires that attempts on world records are the subject of control by the Association Internationale des Automobile Clubs Reconnus, and that one of the conditions laid down is that the instrument used for timing the attempts shall be operated by the actual passage of the car. A special instrument is used, it being agreed that a stop watch could not give the accuracy desired in the measurement of such small intervals of time as is necessary at such high speeds. The records are timed by the Royal Automobile Club by means of an instrument consisting of two pens resting on a strip of telegraph paper, which is mounted on a drum and is revolved beneath the pens. One of the pens is electrically deflected every half-second by a chronometer, tested and examined for accuracy at the National Physical Laboratory, Kew. The other pen is actuated and deflected by an electro-magnet, brought into action by the passage of the car over two metal strips, which run across the course and are kept apart by the inflation of a rubber tube.

The Published Times are Correct

The speed of travel of the paper beneath the pens is such that the half-second intervals on the strips are over 1" in length. This rate of travel is sufficient to clearly record the passage of both the front and rear wheels of the car, even when it is travelling at such speeds as 174 miles per hour.

From these facts it seems evident that the published time, to three decimal places of a second, is most certainly as accurate as it is possible to obtain and, moreover, the record of the speed is achieved without difficulty.

I am glad to be able to give this explanation, more particularly as these records have been such that the difference between one and the other is reduced to a fraction of a second. For instance. the previous speed record (made by the late Mr. Parry Thomas) worked out at a speed of 170.624 miles an hour and was beaten by Captain Campbell, the case in point, who did a mile in 0.436 secs. less than the existing record speed.

Of course Major Segrave's record is on an entirely different footing, for the margin of speed by which the record was made is such that split seconds do not enter into consideration. The matter will no doubt come up again, however, on the next attempt that will be made to exceed the speed of the 1,000 h.p. "Sunbeam," and for which preparations are already being made.

It is unlikely that Major Segrave will be content to rest on his laurels. In any case Captain Campbell who, as already mentioned, previously held the world's record with 174.224 miles an hour, is preparing a new Napier car with which he hopes to beat even the Sunbeam's latest feat.

The Demand for Colour

There seems to be a growing demand for colour, as probably many of my readers became aware when the New Meccano in colours was announced last year. (Incidentally I am able to announce that this year practically all the parts will be coloured).

The demand for brighter colours is not confined to Meccano, however, for recently I have read that an attempt is to be made to induce men to wear brightly coloured suits! My tailor promises me that before long our streets may be brightened not only by the delightful summer dresses of the ladies, but also by the gentlemen appearing in gay suits of saxe-blue, primrose, champagne and other joyous colours! I am told that a beginning has been made and that blue dress suits are already being worn by those who believe themselves to be among the smarter members of society, the traditional black being voted far too dull.

However this may be, I imagine that these innovations will never be allowed to extend to my dress nor to that of many of my readers, for I cannot imagine that a biscuit-coloured suit would be at all improved after a couple of hours of model-building or an afternoon in the garden with a Hornby Train! Apart altogether from such considerations, we are a very conservative people, and I feel sure that boys—and their fathers!—will hesitate before adopting the coloured raiment of their sisters and mothers!

I venture to predict that even if the colour enthusiasts get a run for, say, two or three years, the subsequent appearance of our streets will not be greatly changed as far as the masculine members of society are concerned—for even the much-vaunted "Oxford bags" are now on the decline, and their owners are showing signs of returning to nether garments of more sedate appearance!

"Painting the Town....."

The above remarks are inspired in part by news just to hand that the new sky-scrapers of America are to be coloured. Thus the practice of "painting the town red" may soon become an established fact, although in the case in point it is proposed to introduce additional colours! The whole of the new museum building at Philadelphia, for instance, is to be painted vivid red, blue and green. A building in Park Avenue will have patches of blue, blending into pale buff, with an edging of crimson around the window-frames, roof, and corners of the building.

It is being humorously suggested that in addition to Town Planning schemes, our local authorities in the future will have to consider the suggestion that each building should be finished in certain authorised colours. This is to ensure that an observer from the air will not have his artistic taste offended, but instead will be presented with a view of a perfect municipal colour-scheme!

From the Country

I should like to take this opportunity of thanking several of my readers who, during the past few weeks, have sent me boxes of beautiful spring flowers. How delightful it is to read that: "the woods and dyke banks are covered with violets and primroses"; that "the birds have started building now, and we often find a nest in the hedgerow," or to know that "from my window I see nothing but fields of daffodils, which in the sunshine this morning looked like a great golden carpet." Like the policeman of Gilbert and Sullivan fame, an Editor's life is not always a happy one, but to receive such letters as these, accompanied by daffodils from Devon, and violets and primroses from Lincolnshire, would give pleasure even to an unhappy Editor and make him think it well "worth while" being an Editor after all!

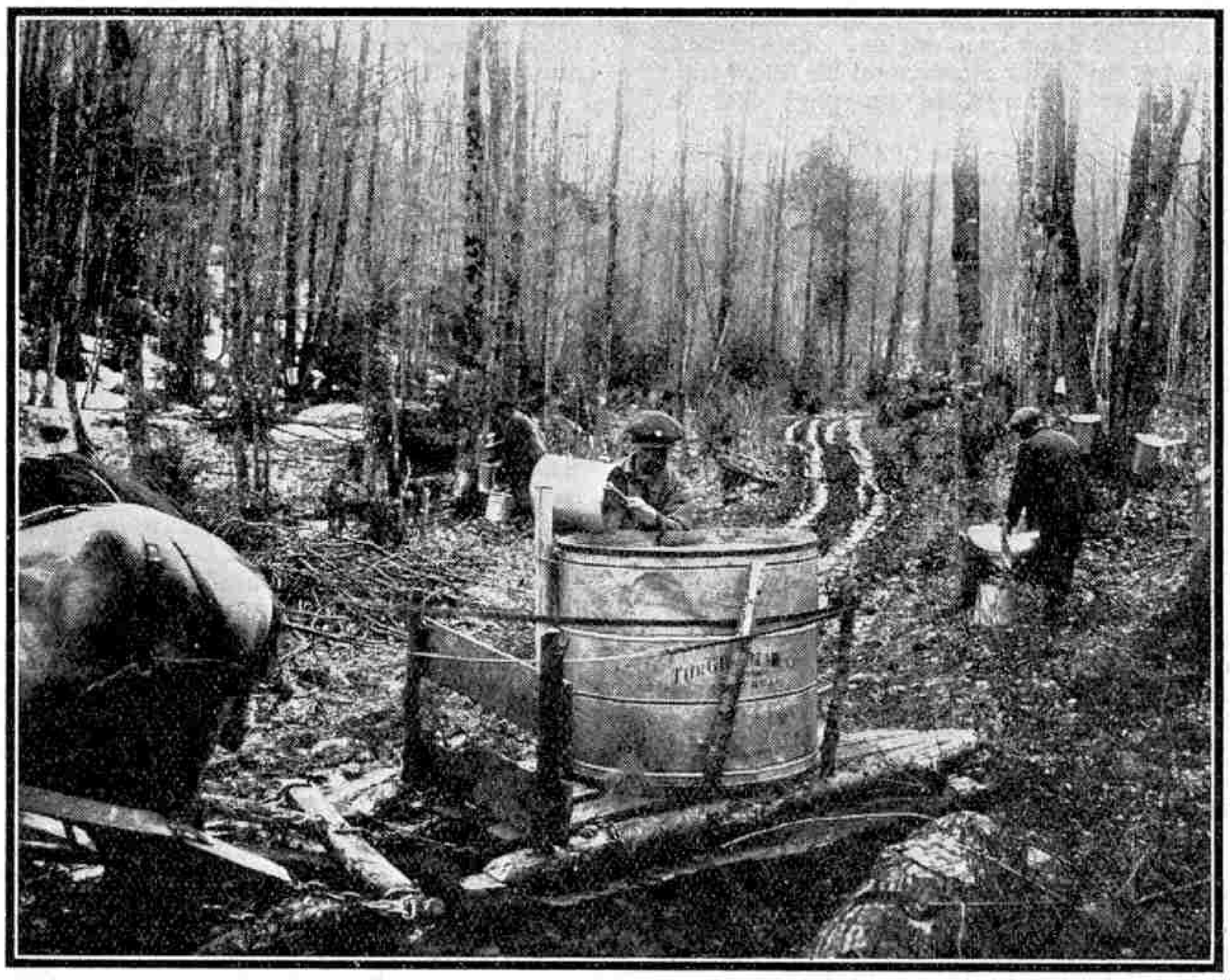
Sugar from Trees!

The Romantic Story of the Maple Sugar Industry

By G. T. Shaw

WHEN the early settlers from England arrived in Canada they found the Indian tapping the maple tree for its sweet sap. The Indian gashed the tree in a slanting direction with his tomahawk, and beneath the opening inserted a wooden chip to direct the fluid drop by drop into a "caso" or birch-bark vessel. This thin liquid was then boiled in an earthen or clay kettle over an out-door fire and the small quantity of dark, thick syrup thus obtained was very highly prized, for in those days it was the only sugar available.

For perhaps a century these primitive methods were followed, the white man introducing little improvement in the crude equipment except for the substitution of iron or copper kettles for the Indian's vessels of clay and birch-bark. During the last 50 years, however, considerable advances have been made in both equipment and methods. The auger is now used instead of the axe to tap the maples and the wooden chip has been replaced by an iron spout. The kettle has been superseded by a pan, which has developed into the modern evaporator.



The sap is poured from the collecting cans into large tanks, carried on sledges and hauled by horses

The sap used for making maple sugar or syrup is produced in the maple tree in the following manner. Moisture in the soil dissolves and holds in solution certain mineral elements. The moisture so charged finds its way to the roots of the tree and then into the wood, in which it ascends to the leaves, through which it passes and from which a very large proportion is evaporated or transpired. From the time the moisture enters the roots until it passes through the leaves it is termed "crude" sap.

Air charged with carbonic acid gas also passes through the leaves and, meeting with the crude sap, gives up to it the carbonic acid and emerges as pure air, while the crude sap with its load of carbon becomes transformed into what is known as "elaborated" sap. In this form it finds its way back into the body of the tree and is conveyed wherever needed to the layer of bark, where it is transformed into the wood that forms the season's growth. The greater part of this sap is the elaborated sap that is used in making syrup and sugar.

When a tree is to be tapped, a hole is bored in the trunk about $1\frac{1}{2}$ in. in depth and from $\frac{3}{8}$ in. to $\frac{1}{2}$ in. in diameter. The boring is made in a slightly upward direction. A very large tree may be tapped in two places. A metal spout is then inserted in each hole and from it is hung a pail capable of holding a gallon or more. A metal cover is fitted to each pail to keep out rain and snow.

The pails are emptied two or three times a day and the collected sap is taken to the sugar house in the grove in 100-gallon tanks to be evaporated. Some sugar bushes have tin pipes radiating from the sugar house and extending to all parts of the bush. This method of conveying the sap is used where the bush is located on the side of a hill so that advantage may be taken of the law of gravity.

As soon as sufficient sap has been gathered to keep the evaporator in operation, it is boiled. This process is necessary because at first the sap is a very dilute solution containing 95 per cent. or more of water, about three per cent. of sugar, and small quantities of mineral matter.

The making of syrup and sugar consists primarily in getting rid of the surplus water, which is accomplished by evaporation. The evaporator consists of a vessel measuring about 3 ft. by 6 ft. divided into compartments and having a corrugated bottom. It is situated over a brick firebox in which wood is used as fuel. The sap enters at one corner and follows a zig-zag course of from 80 ft. to 100 ft. before it reaches the other end. It thickens as it flows and when it has attained the consistency of syrup it is drawn off.

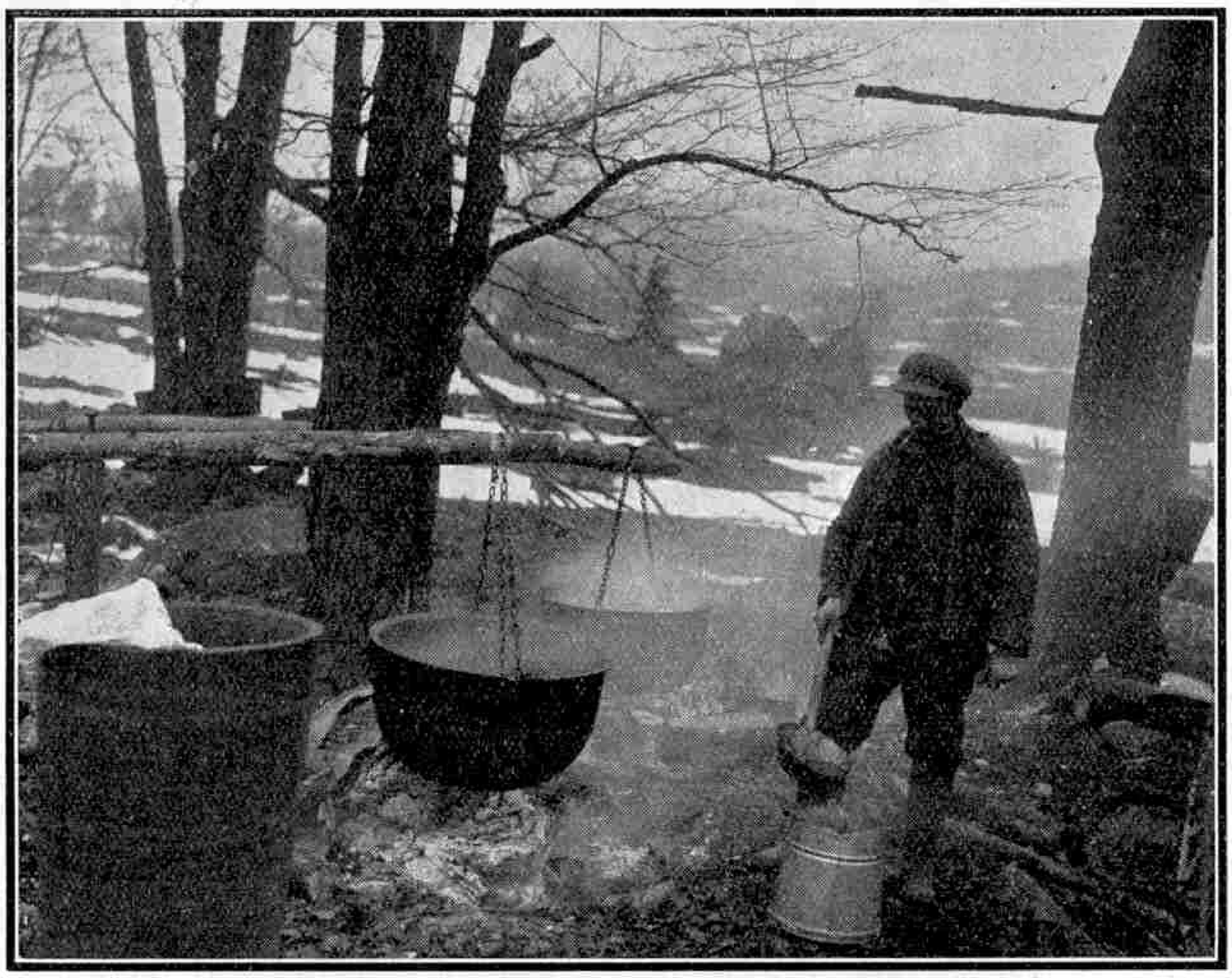
When the sap commences to boil, a coagulation of

albuminous matter is first produced and rises to the surface as a scum, bringing with it other solid matter. This undesirable material is removed as it forms by means of a skimmer. After boiling has proceeded for a certain length of time the mineral salts become concentrated to a point at which they will no longer remain in solution. By the time the syrup has reached the correct consistency to be drawn off, much of this mineral matter has become a sediment and can be removed by straining the hot syrup through a strainer of felt.

The syruping-off point is a delicate one in regard to which the greatest care must be exercised. If not heavy enough the syrup will sour, and on the other hand if too heavy it will crystallise in the storage vessel. With care and by the use of the thermometer or saccharometer, however, the correct point can be determined with accuracy. When in the proper condition the syrup is drawn off at intervals of 10 or 15 minutes.

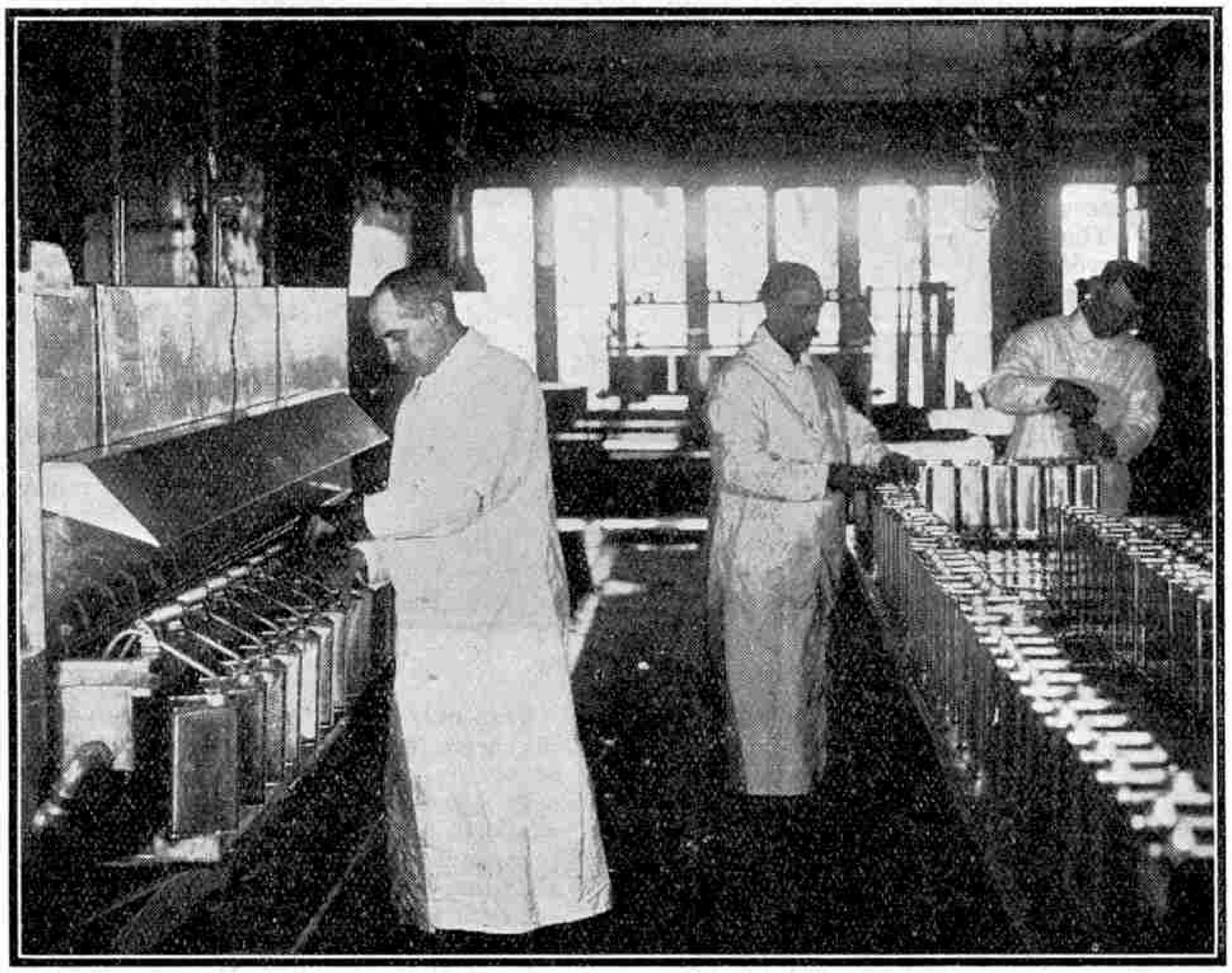
Many makers prefer to use a separate smaller evaporator for finishing the product, and in such cases the syrup is drawn from the first evaporator before the final density is reached. The syrup is not poured directly from the finishing vat to the marketing vessel but is placed to cool in a settling pan.

If the maker intends to produce sugar instead of syrup he subjects the boiling syrup, after it has been strained, to a further boiling in a sugaring-off pan, until it reaches a granulated condition hard enough to cake into sugar. This granulated state may be determined by various methods, for instance by the use of the thermometer. Another test consists of dropping a little of the boiling syrup into a cup of cold water, when, if the syrup forms itself into a hard lump at the bottom of the cup, it is boiled sufficiently. When the correct stage has arrived the pan is removed from the fire and allowed to cool slowly until the syrup begins to thicken, when it is poured into small tins for caking.



The old method of evaporating the sap

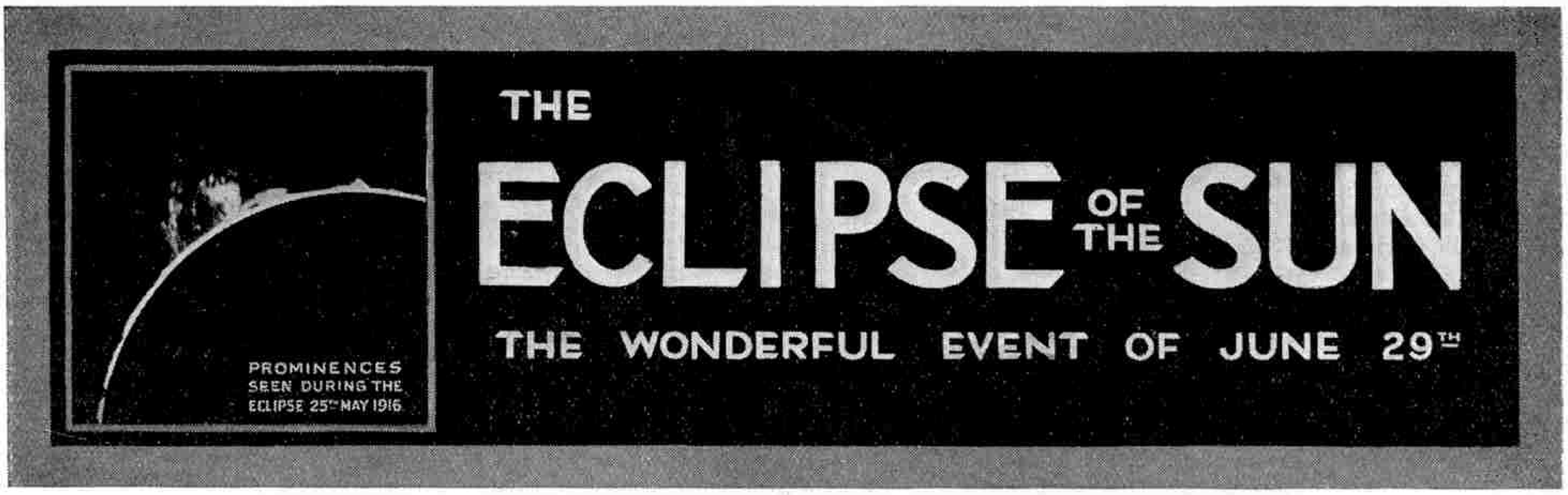
The syrup is canned in either one or two gallon tins; the sugar is formed into bricks weighing from one to two pounds. Both these products have a delicious sweet flavour. The colour ranges from dark brown to amber, the finest grades being represented by the lighter-coloured sugar and syrup, which possess a corresponding delicacy in flavour.



Modern method of canning the syrup

The annual output of maple products in Canada, which forms over one half of the world's production, is valued at over five million dollars. In the year 1925, nearly ten million pounds of maple sugar and over one-and-a-half million gallons of syrup were produced. Ninety-five per cent. of this quantity was produced in the province of Quebec, particularly in that part known as the Eastern Townships, which is south of the St. Lawrence River. Eastern Ontario manufactures a smaller amount, and Nova Scotia and New Brunswick are the other two provinces carrying on this industry.

The industry employs from 50,000 (*Continued on page* 435)



III.—THE STORY OF ECLIPSE EXPEDITIONS

THE earliest eclipse of the Sun in England of which there is any record occurred in the year 538 A.D. The reference to it is very brief, and is to be found in the famous "Anglo-Saxon Chronicle," which says: "This day was the Sun eclipsed 14 days before the Calends of March, from early morning till nine." The eclipse was not total, and calculations made by modern astronomers show that in London two thirds of the Sun's disc was obscured by the Moon.

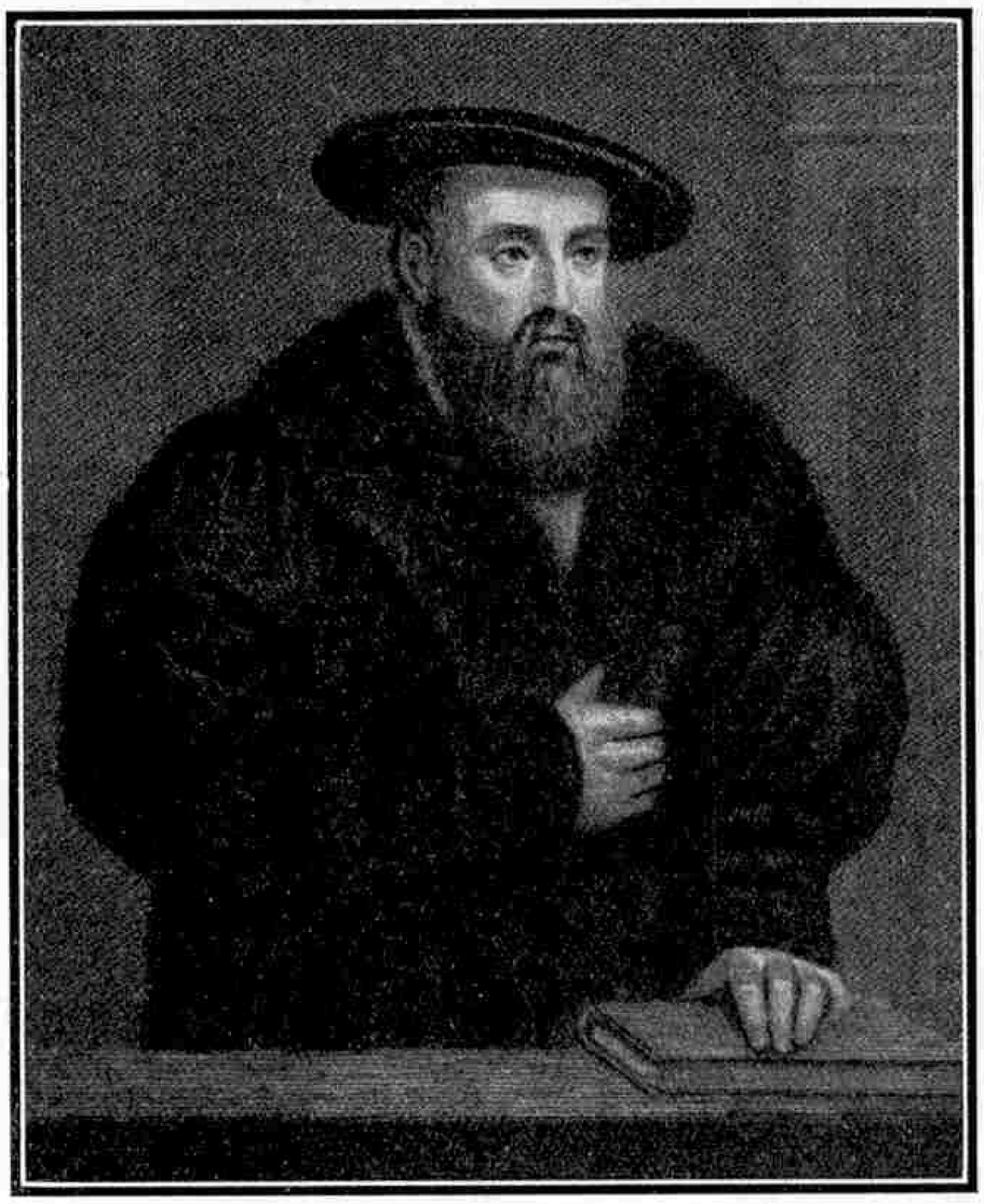
This Chronicle, a brief history of events that occurred in England, was written by monks, and contains several references to eclipses of both the Sun and the Moon. The references are always quaint and generally seek to connect the occurrence with some historical event. Thus in the account of the year 733 we read: "In this year Ethelbald captured Somerton, and the Sun was eclipsed, and all the Sun's disc was like a black shield; and Acca was driven from his bishopric."

In the centuries following there have not been many total eclipses in England, and most of the references given by historians are to partial eclipses.

In 1230 one of the rare total eclipses took place in the early morning of the 14th May, visible from places a little north of London. The chronicle of Roger of Wendover contains the following amusing account of the event.

"On the 14th May, which was the Tuesday in Rogation Week, an unusual eclipse of the Sun took place very early in the morning, immediately after sunrise and it became so dark that the labourers, who had commenced their morning's work were obliged to leave it, and returned again to their beds to sleep, but in an hour's time, to the astonishment of many, the Sun regained its usual brightness."

Scotland was more fortunate than England in the number of total eclipses occurring in historical times. 17th June, 1433, was remembered for many years in Scotland as "Black Friday." The eclipse was observed about 3 o'clock in the afternoon, and as the Moon's apparent diameter was almost as large as possible, while that of the Sun was very small, the darkness was intense. February 25th, 1598, to which the name "Black Saturday" was given, was the date of another total eclipse of a similar character, while in 1652 there was still another eclipse, total at Edinburgh, that was sufficiently impressive to earn a similar title, and was remembered for many years as "Mirk Monday."



J. Kepler

The Earliest Mention of Prominences

In the meantime interest had been taken in eclipses by the famous men such as Copernicus and Tycho Brahe who may be regarded as the founders of modern astronomy. Among these was Kepler who is famous for the discovery of the nature of the paths of the planets around the Sun, and the observations that he made of the eclipse of 1605 are of interest in view of the circumstances of the coming eclipse. It will be remembered from the article in the April "*M.M.*" that the relative positions of the Sun, Moon, and the Earth are such that there is a possibility of seeing the entire chromosphere. Kepler saw the eclipse of 1605 at Naples, where it was total for a few seconds, and his description suggests that the red flames were visible as a ring of light around the Sun's disc. It is not absolutely certain that this refers to the chromosphere, or the prominences, for the recognition of the prominences as a separate phenomenon had not then been made.

About the same time, namely on 30th May 1612, there was an eclipse of the Sun which is remarkable as the first to be seen "through a tube." In other words the eclipse was observed with the aid of a telescope, as had been an eclipse of the Moon two years earlier. In the same century the pendulum clock first came into use also, the astronomer to make use of it for this purpose being Hevelius, at Danzig, in studying the changes that occurred during the eclipse on Mirk Monday, referred to previously.

There is a famous description of an eclipse in Milton's "*Paradise Lost.*"

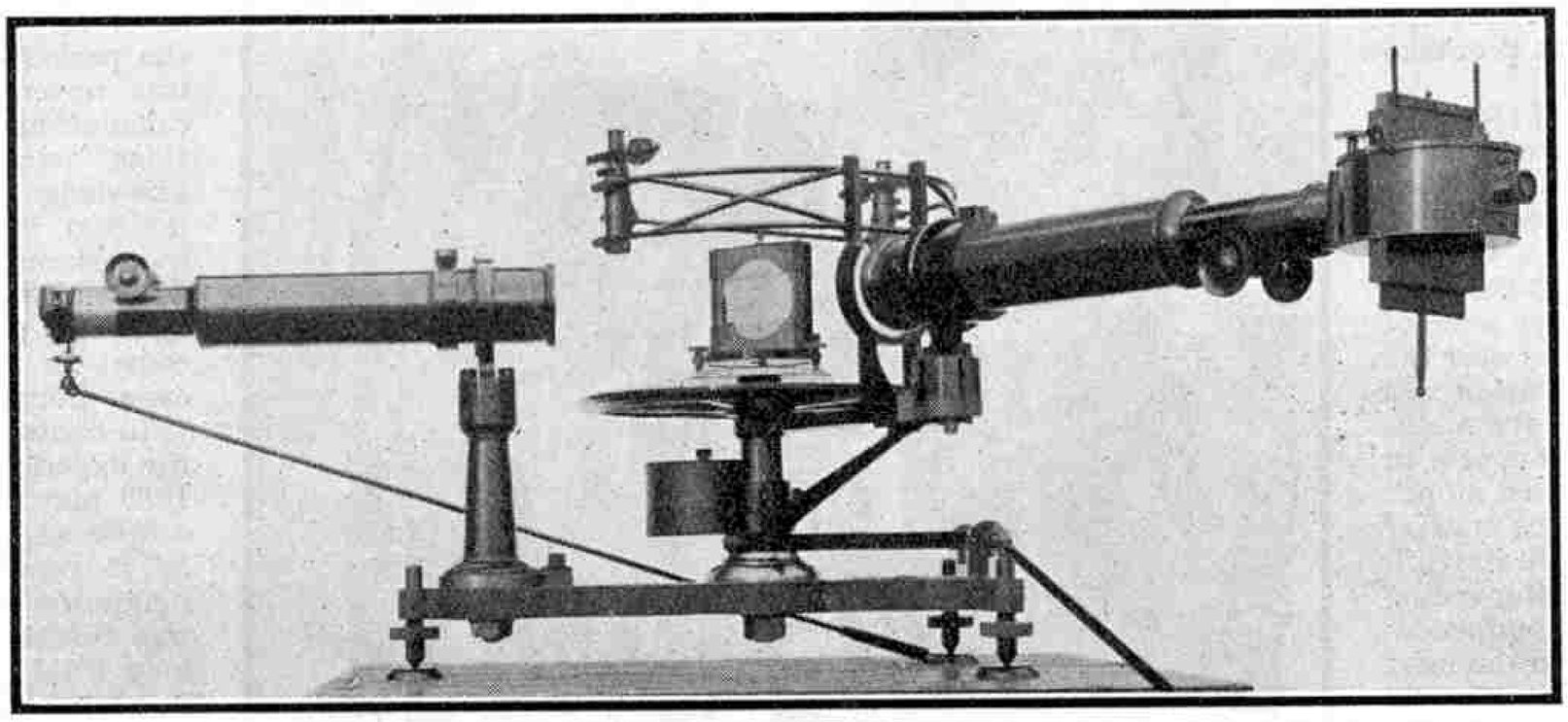
"As when the Sun, new risen,
Looks through the horizontal misty air,
Shorn of his beams; or from behind the Moon,
In dim eclipse, disastrous twilight sheds
On half the nations, and with fear of change
Perplexes monarchs."

This extract really gives the key-note to the ideas of eclipses that were held in the early and middle ages. As already mentioned the "Anglo-Saxon Chronicle" usually connected an eclipse with some catastrophe, and it was the fear that Milton's lines would be interpreted as a reference to the execution of Charles I. that caused Tomkyns, the censor of books, to hesitate before allowing Milton's poem to be published. Quite apart from any political ideas it would be perfectly natural for Milton to make comparisons involving eclipses, as he would have experienced eclipses that were almost total on at least three occasions prior to the final revision of "*Paradise Lost.*" The famous poem was completed by 1665, and the eclipses referred to were those of 1630, 1652 and 1654.

The next eclipses of importance in Great Britain were those of 1715 and 1724, to which reference has already been made in this

series of articles as having been predicted and observed by Halley. Both were total eclipses and there have been no total eclipses in England since. In 1836, however, occurred an example of the nearest approach possible to a total eclipse. This was an annular eclipse, visible as such in the south of Scotland, that is specially noteworthy as it was during his observation of it that Baily first saw the famous "Beads" known by his name and described in the "*M.M.*" last month. It may be remarked also that this annular eclipse passed across the United States on its return in 1854 after the usual 18-year interval, and at the end of a further period was observed in India in 1872. In a few centuries this annular eclipse will become total.

Another annular eclipse of some interest was visible in Great Britain in 1858, the track crossing England from Dorset to Lincolnshire. This eclipse has already been referred to in previous articles as the first for which railway companies ran excursion trains, but unfortunately the weather was cloudy and very little was seen by the excursionists.



Large Grating Spectrometer used for photographing the solar spectrum and the spectra of sunspots

In the meantime a remarkable change had taken place in the attitude of astronomers to solar eclipses. In the past astronomy had been largely a matter of observations and mathematical calculations of the positions of the heavenly bodies, and the chief value of an eclipse had been its use in correcting determinations of longitude and in checking the positions of the Moon. This was now to be supplemented by observations of the phenomena on the Sun itself, such as the Beads discovered by Baily in 1836, as already related.

The Beginnings of Modern Study of Eclipses

In 1842 there was a total eclipse that was visible in the south of France, and the modern study of eclipses may be said to have begun in that year. A large number of astronomers, including Sir George Airy, the English Astronomer Royal, and Arago, the famous French scientist, journeyed to the Alps or the Pyrenees to see the first total eclipse that had occurred within reasonable distance of the British Isles since 1724. At Perpignan, which was on the track of totality, only those unable to leave their rooms owing to ill-health failed to watch the eclipse.

Arago's description of the scenes that were witnessed was extremely vivid and interesting, as the following quotation shows :

"When the Sun, reduced to a very narrow filament, began to throw upon the horizon only a very feeble light, a sort of uneasiness seized upon all. Every person felt a desire to communicate his impressions to those around him. Hence arose a deep murmur, resembling that sent forth by the distant ocean after a tempest. The hum of voices increased in intensity as the solar crescent grew more slender; at length the crescent disappeared, darkness suddenly succeeded light, and an absolute silence marked this phase of the eclipse with as great precision as did the pendulum of our astronomical clock.

The magnificence of the phenomenon triumphed over the petulance of youth, and over the levity affected by some of the spectators. A profound stillness also reigned in the air; the birds had ceased to sing.

After an interval of solemn expectation, which lasted about two minutes, transports of joy and shouts of enthusiastic applause saluted the first re-appearance of the rays of the Sun. The main point of interest consisted in some strange red flames that were seen shooting forth from the black disc in the sky. To solve the nature of these flames, astronomers looked forward to the eclipse in 1851."

It is somewhat remarkable that the "strange red flames," or prominences, were regarded as a discovery. The observations of Captain Stannyan and others at earlier eclipses seemed to have been completely forgotten.

The line of totality of the eclipse of 1851 referred to by Arago crossed Norway and Sweden. It was clearly seen at this eclipse that the red flames that had aroused so much attention in 1842 belonged to the Sun, for the flames on one side of the Sun diminished as the black disc of the Moon passed over, while those on the other side increased. The eclipse was most notable, however, as being the occasion of the introduction of one of the two most valuable instruments, next to the telescope, at the disposal of modern astronomers, namely the camera. Photography was first used at this eclipse by Busch, a German astronomer, at Königsberg, who succeeded in obtaining a photograph showing the corona.

Eclipses were now studied on a larger scale. An example of this was furnished on the occasion of the eclipse of 1860, the track of which passed over the north-west corner of the United States, Canada, Labrador, Spain and Northern Africa, when many expeditions were sent to suitable places, particularly in Spain. As yet the lack of experience was obvious in most expeditions, this showing itself both in choice of positions and in the conduct of the observations during totality.

Importance of Weather Conditions

It is essential to study the weather conditions of a station selected for eclipse observations, and sufficient time must be allowed for the observers to get thoroughly settled in the chosen place. This was discovered too late on the occasion of this eclipse by the members of an American expedition that went to the territory now known as Saskatchewan, then undeveloped. One member of this party afterwards complained that they had travelled 300 miles in five weeks to reach the outer edge of the belt of totality, only to find themselves standing in a marsh viewing the eclipse through clouds!

Another astronomer who would cherish fragrant memories of the eclipse of 1860 was one located in Spain, who carried out a carefully prepared programme of plate changing in his photographic apparatus only to discover at the end that he had forgotten to put the plates in his camera slide!

Accidents of this kind, however, became more rare as careful training and rehearsals became customary, and since that time complete and valuable results have been obtained at almost every total eclipse for which a reasonable observation station could be selected. At the eclipse of 1868, visible in India and Malaya, totality lasted more than six minutes, and it was during this time that the second of the two valuable instruments referred to above came into use with good results. This was the spectroscope. In last month's article its use in enabling the prominences to be seen was referred to, but it is equally useful and important in the study of the composition of the Sun and the stars.

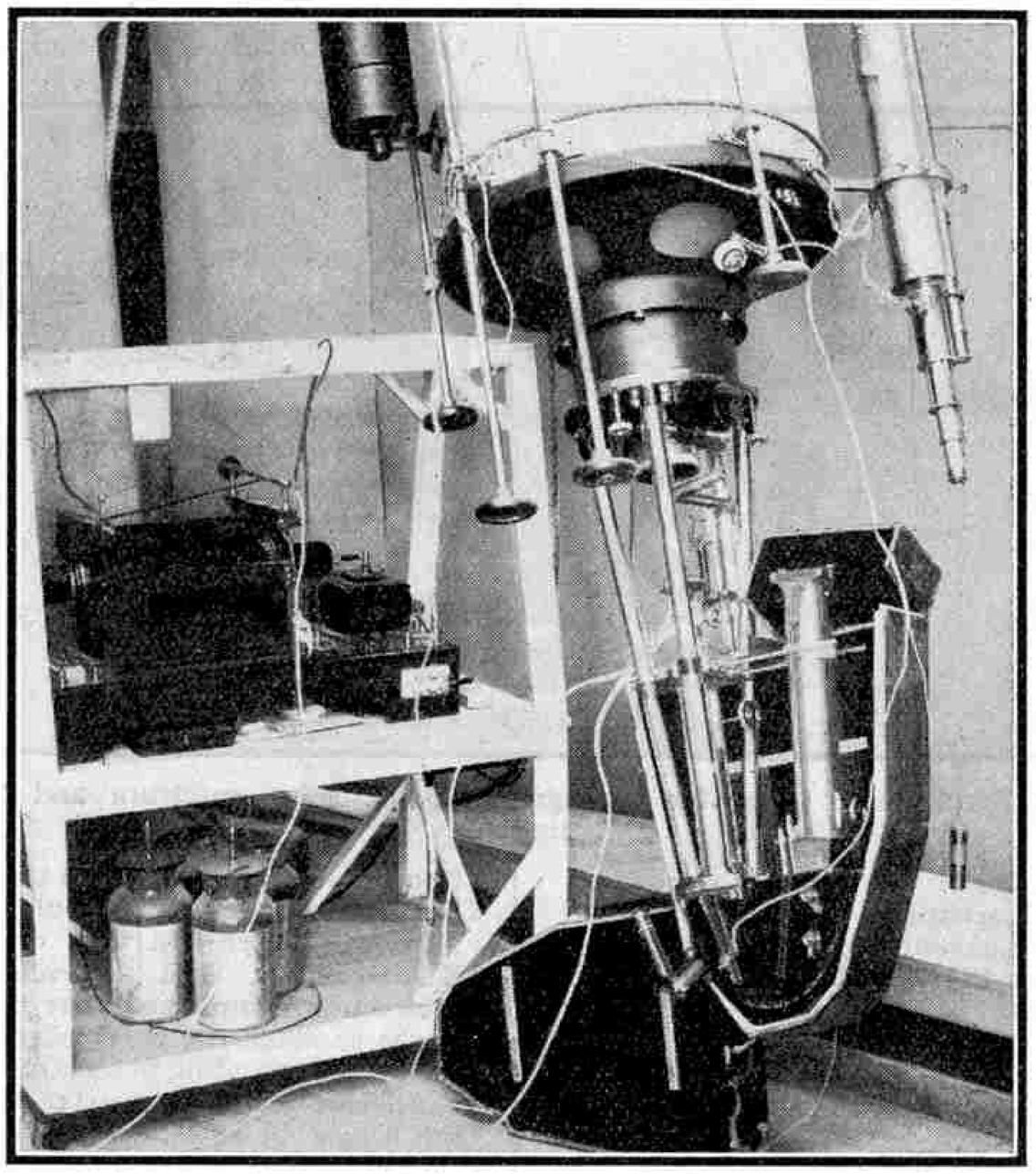
This is accomplished by an analysis of the light given out by them. When any material, such as the gas hydrogen, is heated to incandescence, the light that it gives off is entirely characteristic. Hydrogen can easily be made to glow by passing electric sparks through it, so that there is no difficulty in examining its spectrum. This is not a continuous series of coloured lines as is the case with ordinary white light, but contains comparatively few, and the positions of these lines as measured on a scale are always the same. The importance of the analysis of light by a prism will now be seen. When various observers analysed the light from the prominences during the eclipse of 1868, and found in the spectrum lines in exactly the same places as those previously found in laboratories in the case of hydrogen, they conclued that the prominences contained this gas.

Helium Discovered at Eclipse

Other substances are also present in the prominences, notably the vapour of the metal calcium, but perhaps the most interesting gas present is helium, and the story of its discovery is remarkable. Among the lines in the spectrum of the prominences was a brilliant yellow line that had never previously been seen in the spectrum of any known substance. All attempts to discover its origin failed and finally Sir Norman Lockyer and Professor Frankland suggested that this new line, denoted by the symbol D_3, was due to a new element present in the Sun, but not known on Earth, for which the name helium was suggested.

This was in 1868, and there were no further developments for nearly 30 years. Then in 1895 Sir William Ramsay, Professor of Chemistry at University College, London, was led during the course of his work to examine the gases evolved by heating rare minerals. Among the latter was one known as cleveite, from which he obtained a very small quantity of a colourless gas. He passed an electric spark through the gas and examined the light produced in the spectroscope. To his amazement the line D_3 showed very plainly. He had found the gas on Earth that had been known to exist in the Sun for nearly thirty years! Lately this gas has been used instead of hydrogen for airships, and thus a substance first discovered on the Sun has found practical use on Earth.

The Indian eclipse of 1868 was one of the most important of the long series of total eclipses that have now been observed in a scientific manner. Besides being the occasion of the first successful use on a large scale of the spectroscope it was also the eclipse at which M. Janssen was led to the discovery of the method of seeing the prominences in daylight. As related last month this astronomer tried the method for the first time on the day following the eclipse. After seeing the spectrum of the prominences the idea of seeing it in daylight had been suggested to him by the intense brightness of the lines in it, and the method was immediately successful. He spent about a fortnight in observations before forwarding the news to France, with the result that the Secretary of the Paris Academy of Science announced at the same meeting that Mr. Lockyer, as he then was, had made the same discovery in England.



Spectroscope shown in position in telescope, with cover removed

Sir Norman Lockyer's Great Discovery

The two astronomers were presented with gold medals by the French Government in honour of their discovery. It was certainly a brilliant piece of work, especially in the case of Lockyer, who did not have the advantage of seeing the brightness of the spectrum of the prominences, but was led to it by reasoning alone. The idea had occurred to him about two years previously when he realised that the light of the prominences was invisible because of the clear white light of the sky background upon which they are projected. Unfortunately he had no spectroscope then at his disposal that was capable of spreading out the white light sufficiently and it was not until 1868 that he obtained an instrument powerful enough to give successful results. The curious coincidence resulted of the two announcements being made on the same day, neither astronomer having the least idea of the work that the other was doing.

In the following years astronomers of all nations journeyed to almost every part of the earth in order to observe total eclipses. As early as 1869 they penetrated into Alaska to see an eclipse from a place very near the track of the mad rush to Klondyke nearly 30 years later. India, Malaya, Siam, South Africa, South America, Japan, Siberia, and the Norwegian coast of the Arctic Sea were among the places visited by scientists laden with telescopes, spectroscopes and other instruments.

Sometimes these expeditions were highly successful in results and at other times the reverse. Janssen, the hero of the Indian eclipse of 1868, was besieged in Paris by the Germans when the time arrived to make preparations to see the eclipse of 22nd December 1870, the track of which passed through Gibraltar and Algeria. Not to be deterred, however, he left the city in a balloon on 22nd December taking with him the essential parts of a reflecting telescope. His balloon crossed the German lines in safety and descended near the mouth of the Loire. From there he proceeded to Oran in Algeria, only to find his labour in vain, for clouds covered the sky and observations were impossible.

On some occasions the eclipse expeditions found themselves in very comfortable quarters. Thus the English expedition under Dr. Schuster that went to Siam in 1875 received an excellent reception from the king of that country, who not only gave every possible assistance but even joined the party and made a drawing of the corona himself. Another notable instance of help of this kind occurred in 1882 when many expeditions were despatched to Egypt. They were the guests of the Khedive, and to occasion as little inconvenience as possible they formed one big camp at Sohag. Good results were obtained by members of every party.

Solitary Appearance of a Comet

Perhaps the most remarkable feature of this eclipse of 1882 was the discovery of a small comet near the Sun. This was visible as a very faint object during the period of totality only, but was never seen again. No calculations of its future positions were possible since a knowledge of more than one position is necessary in order to work out the orbit or path of a comet. We never know what an eclipse will bring, but a comet is always a possibility even though a remote one!

In contrast to this expedition the experiences of the eclipse of 1883 may be referred to. This eclipse was of great importance as it occurred at a time of maximum sunspot activity and was further distinguished by a long total phase of more than five minutes, so that it was very desirable that it should be well observed. On this occasion, however, fate ordained that the track should cross the Pacific Ocean, as the map on page 195 of the March "*M.M.*" shows. The only dry land that would afford a foothold for observations was a small group of coral islands on the outskirts of the Marquesas group. One of these, the Caroline Island, was then inhabited by four native men, one woman, and two children, who possessed three houses and two sheds and cultivated a sickly plantation of cocoa-palms. It was on this sparsely inhabited island that groups of hardy astronomers from the United States, Great Britain, France, Italy and Austria descended. As a rule the only visitors to this tiny coral island were the crew of the brig that brought a store of ship biscuits and molasses once a year, so that the excitement produced among the native Kanakas may be readily imagined!

The leader of the French group was the indomitable Janssen, who was more fortunate now than on the occasion of his balloon voyage of 1870. The clouds that at first threatened failure broke up just in time to leave the Sun clear during the minutes of totality and the parties reaped a just reward after travelling thousands of miles.

Over the eclipses of the following years we must pass quickly, noting, however, that the eclipse most eagerly anticipated proved to be extremely disappointing. This was the eclipse of 1886, with a splendid totality of 6 min. 34 secs., which unfortunately was wasted for the most part on the Atlantic Ocean and invisible on account of bad weather at one of the two stations available. Nevertheless two English astronomers, Dr. Schuster and Mr. E. W. Maunder, succeeded in taking good photographs of the corona.

An interesting figure at the eclipse of 1878 was Edison, the great inventor. Prior to the eclipse he constructed a special electrical instrument, which he named the tasimeter, with which he intended to measure the heat radiated by the corona. The invention was highly successful, as Edison's usually were, for it was capable of measuring the heat received on Earth from the well-known star Arcturus, distant thousands of millions of miles away. In fact it was too successful on this occasion, for the heat of the corona was quite sufficient to send the pointer of the instrument right off the scale!

Astronomer who Led Nine Eclipse Expeditions

The most inveterate "eclipser" of the last 50 years was probably Sir Norman Lockyer. As we have already related it is due to this distinguished astronomer that the chromosphere of the Sun may be seen without waiting for an eclipse, and that helium was

recognised as an element long before its discovery on Earth. He was always an enthusiastic worker with the spectroscope and between the years 1871 and 1905 led no fewer than nine eclipse expeditions, visiting among other places Egypt, Lapland, and India, the latter twice. As a result of his great experience and organising powers the expeditions that he led were models, every movement being planned beforehand and carefully rehearsed to avoid mishaps on the great day itself.

The two occasions on which he visited India were in 1871 and 1898. In his account of the latter expedition he comments on the great advance in astronomical knowledge in the interval, but the improvement in the gastronomical conditions of the travelling astronomers was even more remarkable, for on the outward voyage in 1871 passengers and crew were mainly dependent for changes of diet on the rapidly diminishing livestock carried on board, while in 1898 the voyage was made in R.M.S. "*Lusitania*" which was fitted with refrigerating plant and kitchens worthy of the best restaurants in London.

Many other expeditions were attracted to India in 1898. At earlier eclipses the mistake had often been made of crowding the various expeditions together. This was notably the case in 1896, when several parties were assembled on the shores of the Varanger Fiord in Lapland, with the result that all experienced the same bad weather conditions that rendered observation practically useless. No results of any value would have been obtained on that occasion had it not been that Sir Norman was able at the last moment to despatch a minor expedition to Nova Zembla. Mr. Shackleton, the leader of this little party, found it impossible to reach a position on the central line of the belt of totality, but in spite of somewhat inadequate equipment excellent results were obtained.

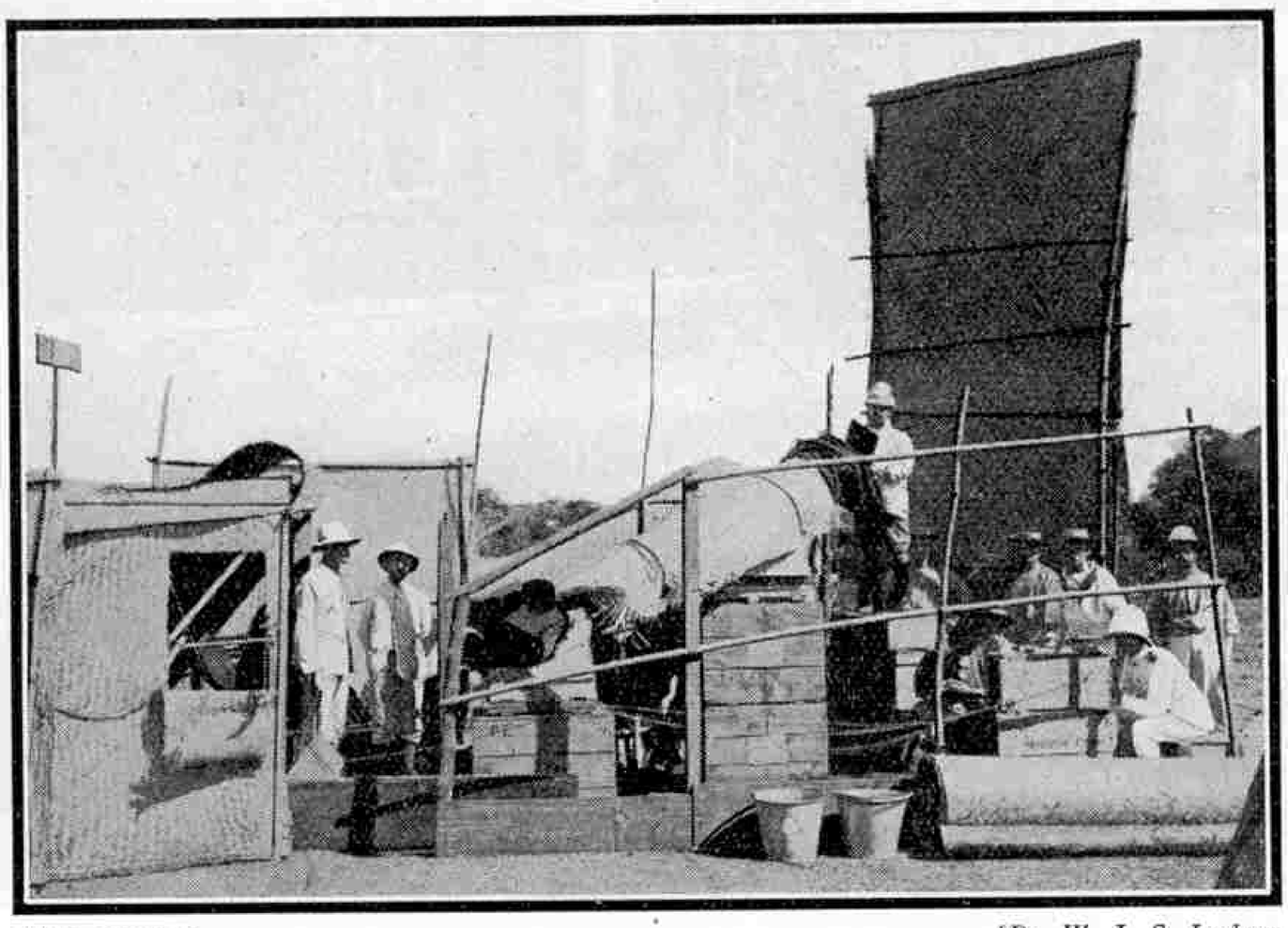


Photo courtesy] [*Dr. W. J. S. Lockyer*

The 9 in. prismatic camera as worked by Dr. William J. S. Lockyer at the eclipse in India on 22nd January 1898

In 1898, however, this mistake was avoided. The line of totality stretched from the western coast of the Indian peninsula to the Ganges and beyond, and by friendly arrangement the various expeditions were scattered along the line so as to be independent so far as possible of weather conditions that were merely local. Altogether there were ten parties of astronomers in India and they took up positions at seven different places. Five of the parties were from Great Britain. Included among the leaders of these were many well-known British astronomers, including Mr. Christie, the Astronomer Royal, Dr. Copeland, who held a similar post in Scotland, and Professor H. H. Turner, the latter of whom will be in charge of the observations at Southport during the coming eclipse.

Sir Norman's party was one of the three sent out by a joint committee of the Royal Society, and the Royal Astronomical Society. Fortunately the date, 22nd June, was in the middle of the cold weather and reports from Indian weather experts indicated that the chances were greatly in favour of excellent weather. The Government gave considerable assistance, H.M.S. "*Melpomene*" being detailed to assist the astronomers. In addition the Government of India undertook to provide accommodation in the shape of bungalows and tents, bricks and other materials necessary for the erection of platforms for the instruments, and police to prevent intrusions by the natives in the district where Sir Norman established his station.

After a careful study of the conditions Viziadrug was chosen by Sir Norman. This village, on the coast south of Bombay, is centred around the ruins of a fort that was the stronghold of the famous pirate Angria in the eighteenth century. It had been the scene of fierce fighting in 1755 when Admiral Watson, supported by a small army under Clive, put an end to the pirate's activities by defeating his fleet and destroying the fort. As there were a few modern buildings within the ruined walls headquarters were set up in the fort itself which provided good shelter and even weights for driving the clocks in the shape of cannon balls used during the assault 150 years previously.

The first task was to land and set up the instruments. It was necessary to mount the telescopes and reflecting mirrors so that the clockwork would turn them in order to keep the Sun in the field of vision automatically during the eclipse. Further, nearly every astronomical instrument requires to have some definite relation to the earth's axis, so that true north and south lines had to be marked. In the past the stands for the instruments had been usually brought out with the instruments. These were invariably heavy and had sometimes proved difficult to handle in the remote parts to which the astronomers had been lured by an eclipse. Thus in Egypt in 1882 the difficulty of getting one heavy pillar ashore from a barge on the Nile over a single plank had been solved by the drastic method of strapping it to the back of a giant Sudanese and flogging him up the narrow gangway. Needless to say Sir Norman was not responsible for this brutality and the sight of it caused him to resolve on the spot that such a thing should not be possible in any future expedition in which he was concerned. His new method was to make wood and paper moulds of the pillars and to erect concrete replicas of them on arrival at the chosen station. The instruments when erected were protected by sheds, and the necessary photographic dark-rooms constructed.

The men of H.M.S. "*Melpomene*" rendered valuable assistance in the work of landing the equipment, and volunteers from among them made up the observing party to no fewer than 120 men. British sailors have always been willing to vary the monotony of ship-life by good work of this kind and they take such tasks very seriously. In fact an American astronomer, Professor W. W. Campbell, who came out to India alone for this eclipse, obtained all the skilled assistance that he needed from naval officers who responded to his request for volunteers.

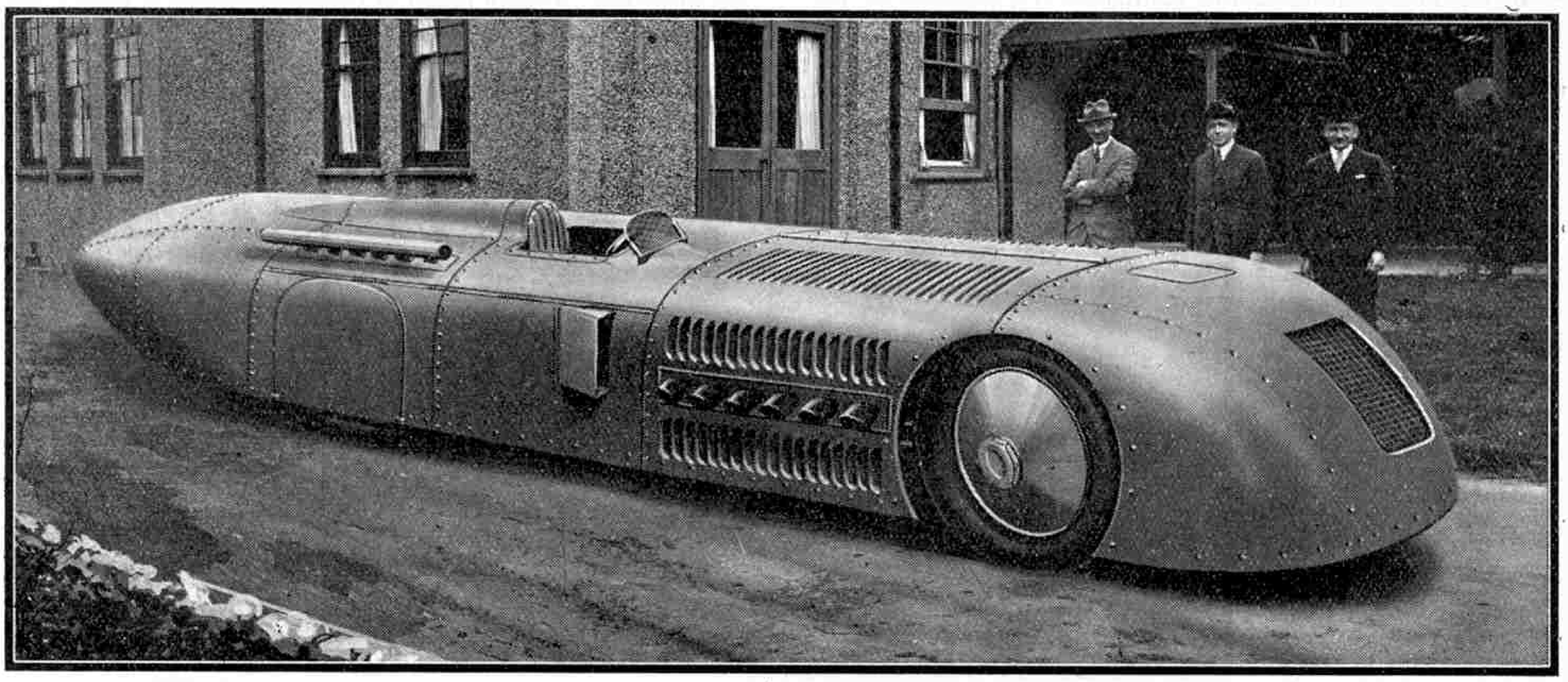
For some time before the eclipse lectures were given to the volunteers with practice in drawing the corona and making other observations under conditions as near reality as possible. In dealing with the corona for instance, a photograph was exhibited on a screen for the length of time that totality would last at the forthcoming eclipse. The station was then divided into parties to which were assigned various duties. Rehearsals were carried out with the actual instruments until each man knew exactly what he was expected to do during the two minutes of totality, with the result that everything went like clockwork on the 22nd January.

Actually everything went by clockwork also. Various observations were made from the time that the Moon first began to cover up the Sun and all parties were warned by bugle calls a few minutes before the eclipse became total. The leader of the expedition himself kept his eye glued to the eyepiece of a telescope through which he observed the exact moment at which totality commenced, when he gave the signal " go " to the time-keeper. This individual then released the pendulum of his clock. Thereafter the silence of the old fort was only broken by the voice of the time-keeper calling out at short intervals the number of seconds of totality still left, and the sharp commands " Snap," " Expose," and so on, of those in charge of the various instruments. The natives were rigorously kept at a distance to avoid the possibility of distraction by their noisy demonstrations ; even a troop of monkeys nearby stopped feeding and gazed around in bewildered silence.

On the walls of the fort black discs varying from 2 inches to 6 inches in diameter had been set up and eye-holes arranged some 20 to 40 feet away. Behind each eye-hole sat one of the tars of the "*Melpomene*" industriously sketching the corona that alone of the phenomena would be visible to him, the size and distance of the black discs having been so arranged as to cut off his view of the Moon and the chromosphere and in some cases of the lower part of the corona also. (*Continued on page* 469)

Over 200 Miles an Hour

Major Segrave's Great Feat



ON Tuesday, 29th March, the world's motoring speed record was not merely beaten, but shattered, by Major H. O. D. Segrave, who drove a Sunbeam car along Daytona Beach, Florida, at the amazing speed of 207.015 miles per hour.

The new record was the climax to a series of attempts to secure the honour that have been made by three great drivers. First Captain Malcolm Campbell succeeded in reaching the speed of 174.224 miles per hour on Pendine Sands, South Wales, in February last, then Mr. J. G. Parry Thomas was unfortunately killed in an accident to his car on the same track while trying to beat this record; and now the third of the famous trio, Major Segrave, has exceeded the previous record by no less than 30 miles per hour.

Major Segrave's World Records

1 mile	203.841	miles per hour
1 kilometre ...	202.541	" " "
5 " ...	203.616	" " "

A British-made Car

It is interesting to note that the new record was set up with a British-made car, and the accomplishment of the feat is greatly to the credit of the British motor industry in general and of the Sunbeam Motor Car Co. Ltd., Wolverhampton, the makers of the car, in particular. The car was designed to reach the speed of 200 miles per hour, and makers and driver alike were confident that this speed would be attained. Unfortunately there is no track in England long and safe enough to give such a car a fair run, and so Major Segrave was compelled to take his huge red car to the famous Daytona beach.

In one of the preliminary attempts the car reached the speed of 166 miles an hour and it was decided to make a further trial on 29th March. On that date the weather conditions were better than they had been previously, as a brisk north-east wind and high tides had combined to smooth the beach to fine condition. No vehicles were allowed to ruin the surface, the only cars on the beach being the lorry that towed the racer to the course, the touring cars of the officials—and, ominously, an ambulance car! Fortunately the last-named was not needed.

A Mile in Seventeen Seconds!

Finally the car was started over the nine mile course. The first run was in the northerly direction against the wind. The huge car gathered speed quickly in the preliminary four miles and covered the measured mile in 17.94 seconds, which works out at an average of 200.668 miles per hour. The remaining four miles were required to bring the car to a stop. The car was then turned round while the timing device was being re-adjusted, and again it swept along the course. This time, with the wind behind him, Major Segrave covered the measured distance in 17.39 seconds, reaching the amazing speed of 207.015 miles per hour!

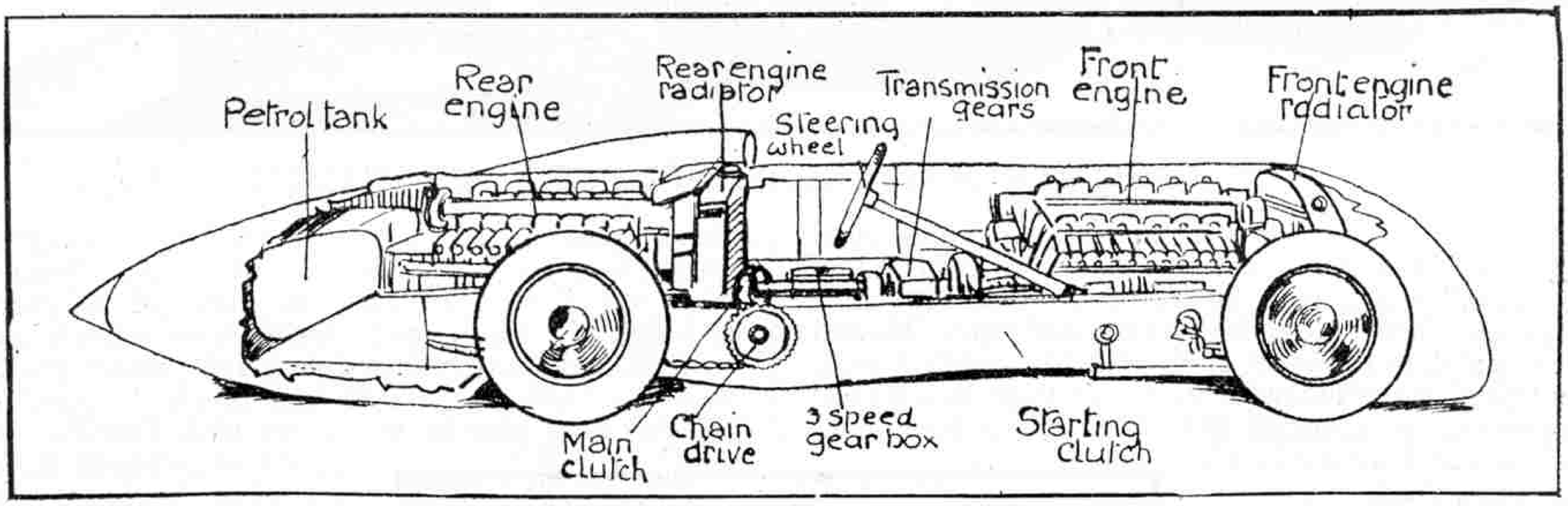
The machine shot like a projectile past the 7,000 spectators, who caught only a momentary glimpse of the strained features of the driver. One account of the attempt describes the passage of the thousand horse-power monster as "a rushing blur enshrouded in a cloud of sand."

Conditions for Records

The actual figures of the records established are of great interest. It must be remembered that no record is accepted unless the measured distance has been

covered in both directions and the speed is calculated from the average time for the two runs. This is done to prevent advantage being taken of such accidental circumstances as high wind or a sloping course. Electrical timing apparatus is always used as no human being is able to record the moment of the passing of a "rushing blur in a cloud of sand" with sufficient accuracy. It was under these conditions, then, that the Sunbeam made the world's records shown on the previous page.

These figures do not show the greatest speed at which the car travelled. As already mentioned the car actually covered the course in one direction at 207.015 miles per hour. This works out at more than 100 yards per second, and one way to realise what a speed of 200 miles per hour means is to measure out the distance of 100 yards, take out your watch—and think!



Courtesy] ["*Liverpool Echo*"

Diagram to illustrate the arrangement of the main parts of the car

Major Segrave's Career

Major Segrave is an experienced racing motorist. He is of Irish descent, was born in America, and received his education and training in England. He adopted a military career and during the war became a member of the Royal Air Force. Later he began to take an active interest in motor racing. Since his first appearance at Brooklands in 1920, his career has been eventful. He has won numerous races on the track at Brooklands, and in addition has been successful in the great road races, the French and the Spanish Grand Prix, to win which is the ambition of every racing motorist. Most of his successes have been obtained in association with the famous designer Mr. Louis Coatalen, who is responsible for the Sunbeam car with which the great feat has been accomplished.

After the trial Major Segrave confessed that he had practically no control over the car at the speed of 200 miles per hour, as the wind pressure created by such a speed in the face of the head wind was so great that it made steering almost impossible. New steering gear, a new braking system, and a different distribution of weight will be necessary if cars to travel at this speed are desired, as the present equipment answers so slowly as to make the controls inadequate.

Features of the 100 h.p. Sunbeam Racer

The racer itself is the most amazing motor car ever devised. It is very striking in appearance, as a glance at the illustration shows, and gives a fine impression of power and capacity for speed. Two engines are used. Each is a 500 h.p. Aero engine of the "Matabele" class, manufactured by the Sunbeam Company, and modified in various ways for use on the road. One of them is mounted at the front of the chassis in the conventional position, while the other is placed in the rear of the car, behind the driver.

Each engine has 12 cylinders mounted in "V" fashion upon the crankcase. The bore and stroke is 122×160 m.m. and the total volume swept by the 24 pistons is 44,888 cubic centimetres which, by the way, is over 58 times the capacity of the "Baby Austin"—one of the smallest cars made. As each cylinder has four valves and two sparking plugs, 96 valves, 48 sparking plugs, 8 magnetos and 4 carburetters are used to attend to the needs of the giant power units.

The two engines are connected by a shaft and behind the foremost engine there is a clutch. The front engine is started first and then the clutch is engaged to set the rear engine in motion. The shaft connecting the engines carries a gear which meshes with another on the front end of the gearbox, but interposed between this gear and the gearbox is the multi-plate clutch used for driving the car.

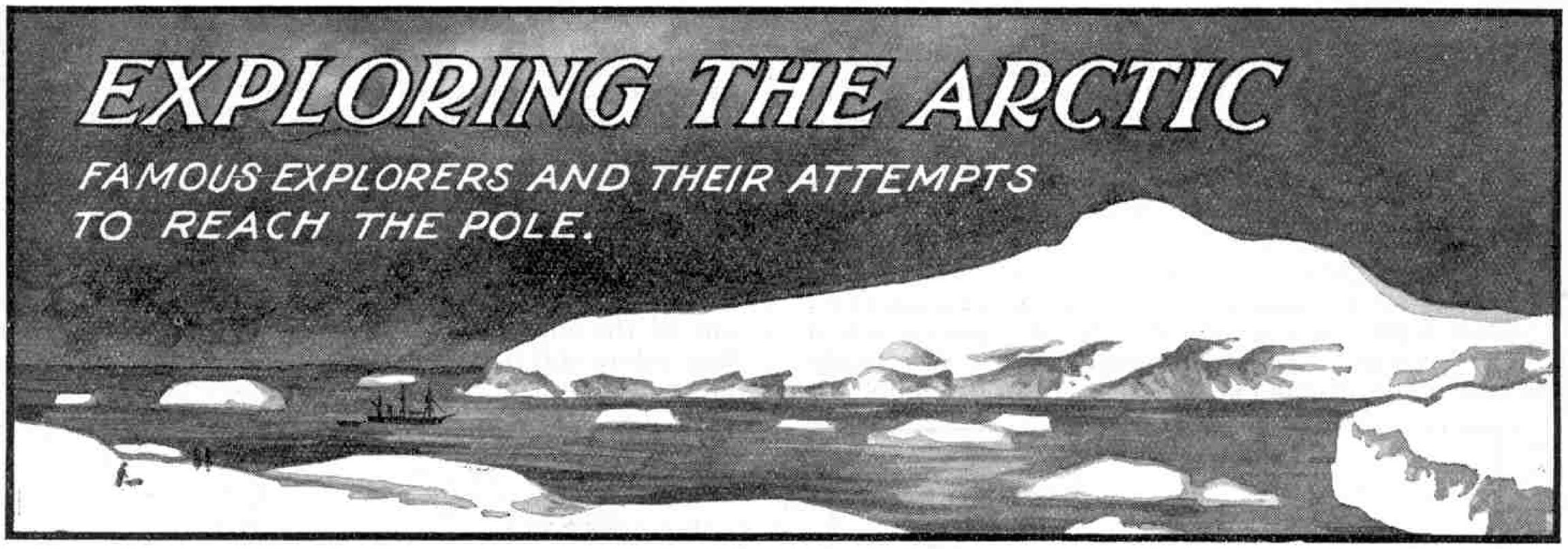
On an ordinary car the gearbox shaft is direct driven by the engine and runs at engine speed, but on this machine it is geared up to rotate at 2½ times engine speed. The reason for this unusual feature is that the increase in speed results in a proportional reduction in torque and consequently the size and weight of the box can be reduced. Three speeds are provided.

Aft of the gearbox is a bevel-driven countershaft which is connected at each end to the rear wheels by Coventry roller chains. The use of chain drive may strike the reader as curious, but it must not be forgotten that the mounting of an engine at the rear makes the fitting of a conventional type of axle extremely difficult. Apart from this a live axle capable of bearing the weight of the car in addition to transmitting the thrust of 1,000 horse power would, in any case, be prohibitively heavy. The arrangement chosen has the advantage of minimum unsprung weight.

The Unusual Shape a Safety Measure

The frame side members are very deep in section and the axles pass through suitable slots in them. Several powerful cross members render the frame inordinately stiff and under it there is a punt-shaped steel cover which extends the complete length of the car. A small ground clearance is given so that in the event of a tyre burst the car can slide along on its steel-clad stomach and so come to rest without the risk of turning over or being jarred to pieces.

(*Continued on page* 453)



IX. CAPTAIN BACK AND SIR JOHN FRANKLIN

AS we saw in our last instalment, Sir James Ross spent four winters in the Arctic with the "*Victory*," which ship he abandoned (in 1832) after it had been frozen in the ice for the third time. He and his men took to the boats and reached Leopold's Island. After passing the following winter at Fury Beach they were picked up in August 1833 off Lancaster Sound and reached the Humber in the same year, much to the relief of those at home, who had given up the expedition for lost.

In the meantime, Captain Back sailed (in 1833) in search of Ross whose prolonged absence was causing much anxiety. Back was absent for two years on this expedition, during which time he travelled 7,500 miles and discovered the Great Fish River. This was not his first experience of the Arctic, however, as he had previously been there with Franklin.

He subsequently became an admiral, and was the hero of many polar expeditions.

George Back was a native of Stockport in Cheshire, where he was born in 1796 and he entered the navy in 1808 as a midshipman on board the "*Arethusa*." In the following year he was taken prisoner by the French at Deva, whilst on a cutting-out expedition with the "*Arethusa's*" boats, and along with his fellow captives was sent to San Sebastian. This was quite an adventure for the boy, who was small enough to be carried over the Pyrenees in the pannier of a mule. While imprisoned at Verdun Back studied mathematics, French and drawing, which studies were greatly to his ultimate advantage. He was released in 1813 and spent the winter in travelling on foot through part of France.

We next hear of him as a midshipman on the "*Akbar*," and he was with this ship in North American waters during part of the French war. On one occasion, during very rough weather, the ship nearly foundered when off Cape Hatteras, but managed to survive, although the masts and rigging were carried away.

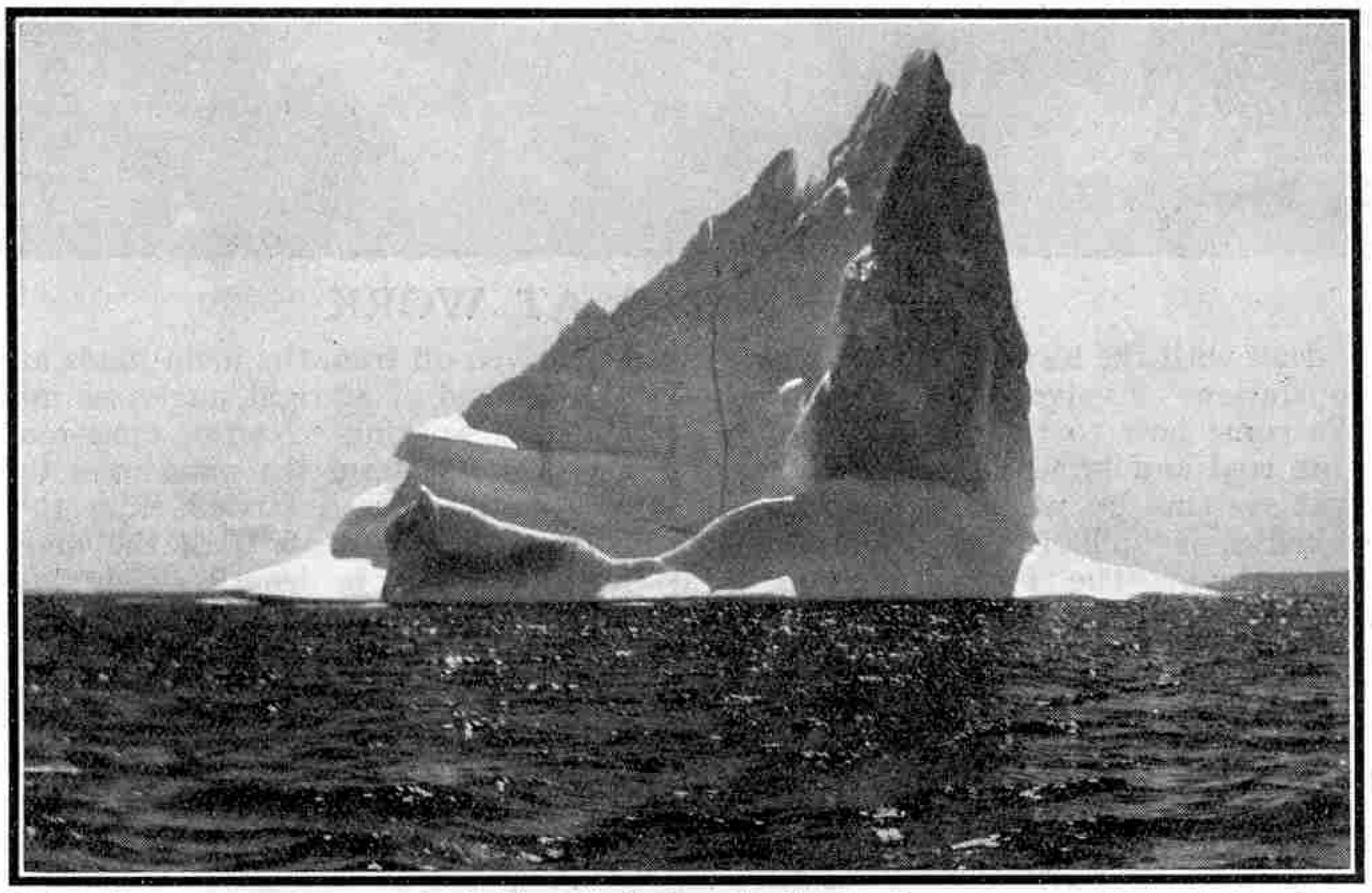
In 1818 Back volunteered for service under Franklin, who was sailing to Spitzbergen in the "*Trent*." In the following year he was again with Franklin in an expedition to North America to explore the coast east of the Coppermine River, discovered by Samuel Hearne who had once been a midshipman in the Royal Navy. Hearne was an official of the Hudson Bay Company, quartered at Fort Prince of Wales at the mouth of the Churchill River. He became an ardent explorer, being sent out in 1769 to explore the northwest owing to Indian reports of rich deposits of copper and an abundance of fur-bearing animals. His first expedition was a failure but he set off again in 1771, with an Indian chief, named Matonabbee, and after suffering terrible hardships and travelling 1,300 miles to the west, he discovered the Coppermine River and the Great Slave Lake. He traced the river to its mouth and emerged on the northern shore, being the first white man to see the Arctic Ocean between Boothia and the Bering Strait. On his return Hearne was appointed governor of Fort Prince of Wales, which position he held for ten years, when the fort fell before a vastly superior French force. He was taken prisoner and with his capture his active life ended, for he returned to England in 1787 and five years later he died.

Captain Back, R.N.

It is interesting to know that one of the Indians, known as "English Chief," who was with Hearne, accompanied Sir Alexander Mackenzie, another explorer, in this district, when, in 1789, he took four birch bark canoes and started down the Great Slave River to the

Great Slave Lake. Twenty days were occupied in crossing and exploring this vast sheet of water at the expiration of which Mackenzie entered the large river that now bears his name. Amid many dangers and difficulties the explorers sailed down it, overcoming all obstacles by skill, precision, force and good fortune, and reached the sea on the 14th July.

To return to Back—the object of Franklin's 1819 expedition to the Coppermine was to explore the coast between the furthest point reached by Hearne and the Hudson Bay—a tract of practically virgin country. They were then to travel eastward along the coast, and if possible effect a junction with Parry, who had sailed in the "*Hecla*" and "*Griper*" as has already been described in these articles. In addition to Back, Franklin was accompanied by Dr. Richardson, a naval surgeon and a keen and well - trained scientist; Robert Hood, who had served with Back as midshipman in the "*Trent*;" and two seamen and four boatmen from the Orkneys.



Photograph] **A Gigantic Iceberg in the Arctic** *[Scientific Illus. Bureau*

The expedition left England on 23rd May 1819, and arrived at York Factory on the western shore of Hudson Bay on 29th August. Here they remained for a week collecting stores and equipping a boat, and finally started on their journey on the 9th September. Franklin's idea was to follow the rivers, using canoes wherever possible until he came to the Great Slave Lake and the Coppermine River.

The country from the south to the north had previously only been crossed by Hearne and Mackenzie, and the overland journey was a hazardous undertaking. No-one knew what difficulties and dangers might have to be contended with, nor how great were the risks of perishing through intense cold and starvation. Progress was slow and difficult, for the boats were heavily laden and there were numerous rapids on the river. After lightening the boat they managed to drag it over the smaller rapids, but when it came to negotiating the steeper waterfalls, the boat had to be emptied and carried over dry land to the next stretch of water. In all the boat was carried bodily for 21 miles, but on each occasion seven trips had to be made to transport all the stores, so that the distance actually traversed on foot in this way was nearly 150 miles.

After a wearying journey of nearly 900 miles the party reached Fort Cumberland on the 23rd October. Here Franklin had expected to find guides and hunters, but as none were obtainable, this necessitated a long journey to obtain the assistance without which the expedition could not proceed. Richardson and Hood were left at Fort Cumberland to follow, as soon as the river was navigable, with the stores and provisions in the boats, and taking Back and one seaman, Franklin started out on foot for Fort Chipewyan, with two dog sledges and fifteen days' rations.

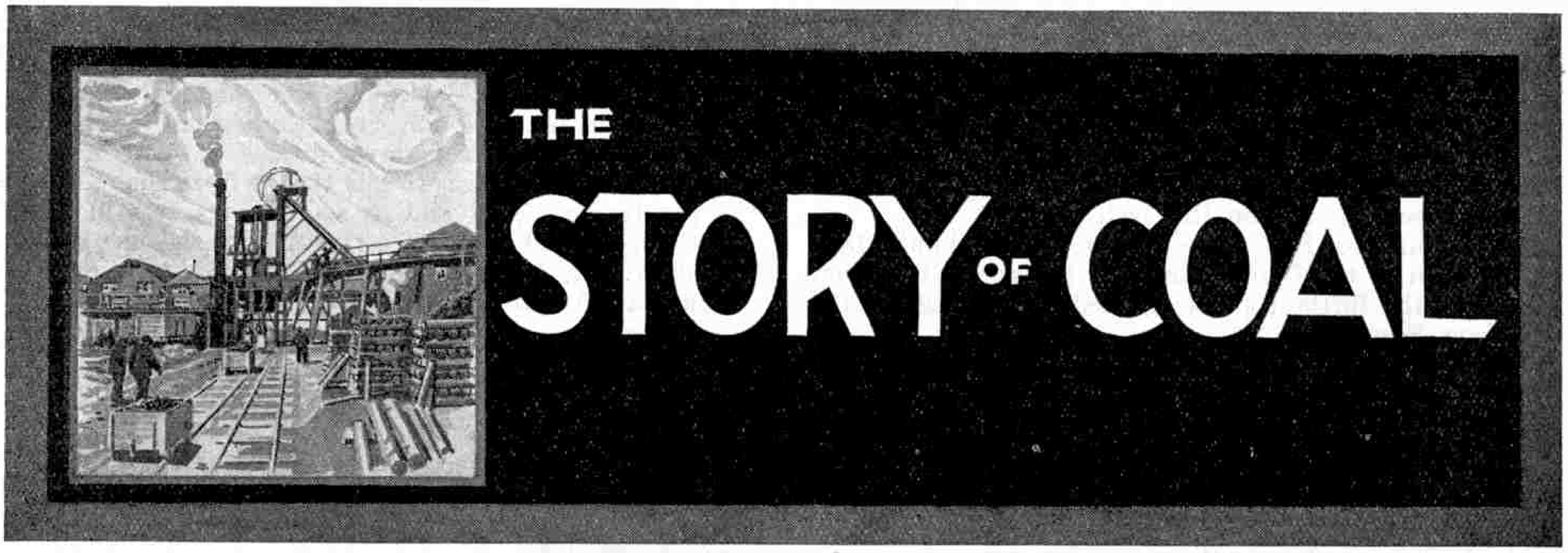
The temperature was so low that it froze the mercury in the thermometer, and as soon as tea was made it was frozen solid in the tea-pots before the men could drink it. At last they reached their destination (on 26th March) and here they spent the rest of the long dreary winter, without, however, being successful in obtaining the assistance they desired.

Richardson and Hood having in the meantime rejoined them, the expedition left (on 18th July) for Fort Providence on the northern shore of the Great Slave Lake. They had only a scanty supply of ammunition and only sufficient provisions for about a day. They supported themselves by hunting and fishing and arrived at their destination on the 29th July, leaving again on August 2nd. At Fort Providence they had been successful in obtaining assistance and the expedition now consisted of twenty-eight people including Canadian guides, hunters and interpreters. The number was further increased when they were joined, on the 2nd August at the mouth of the Yellow Knife, by a band of Indians and a chief named Akaitcho, in seventeen canoes. The Indians agreed to guide the party and to supply them with food. Game and fish proved scarce, however, and even when it was found the Indian marksmanship was so bad that provisions were generally short and the journey was undertaken under hazardous conditions.

They arrived at Winter Lake (64° 38′ N. latitude) on 20th August and here log huts were built named Fort Enterprise. Situated on a hillside, amidst trees that were 3 ft. in diameter at the roots, the explorers had a wonderful view, and with such consolation as this fact offered, they prepared to spend the winter—which had come earlier than expected. It was a winter of exceptional severity, the cold being so intense that the trees froze to their centres and became as hard as stones so that in trying to chop wood all the axes were broken.

When ammunition and tobacco ran short, Back volunteered to return to the forts and bring up the supplies that had not come forward as expected. He reached Fort Providence, and sent back letters and 100 bullets by one of the Canadians, named Belenger, who arrived at Fort Enterprise on the 23rd October, encrusted in ice from head to foot.

(To be continued)



IV.—THE MINER AT WORK

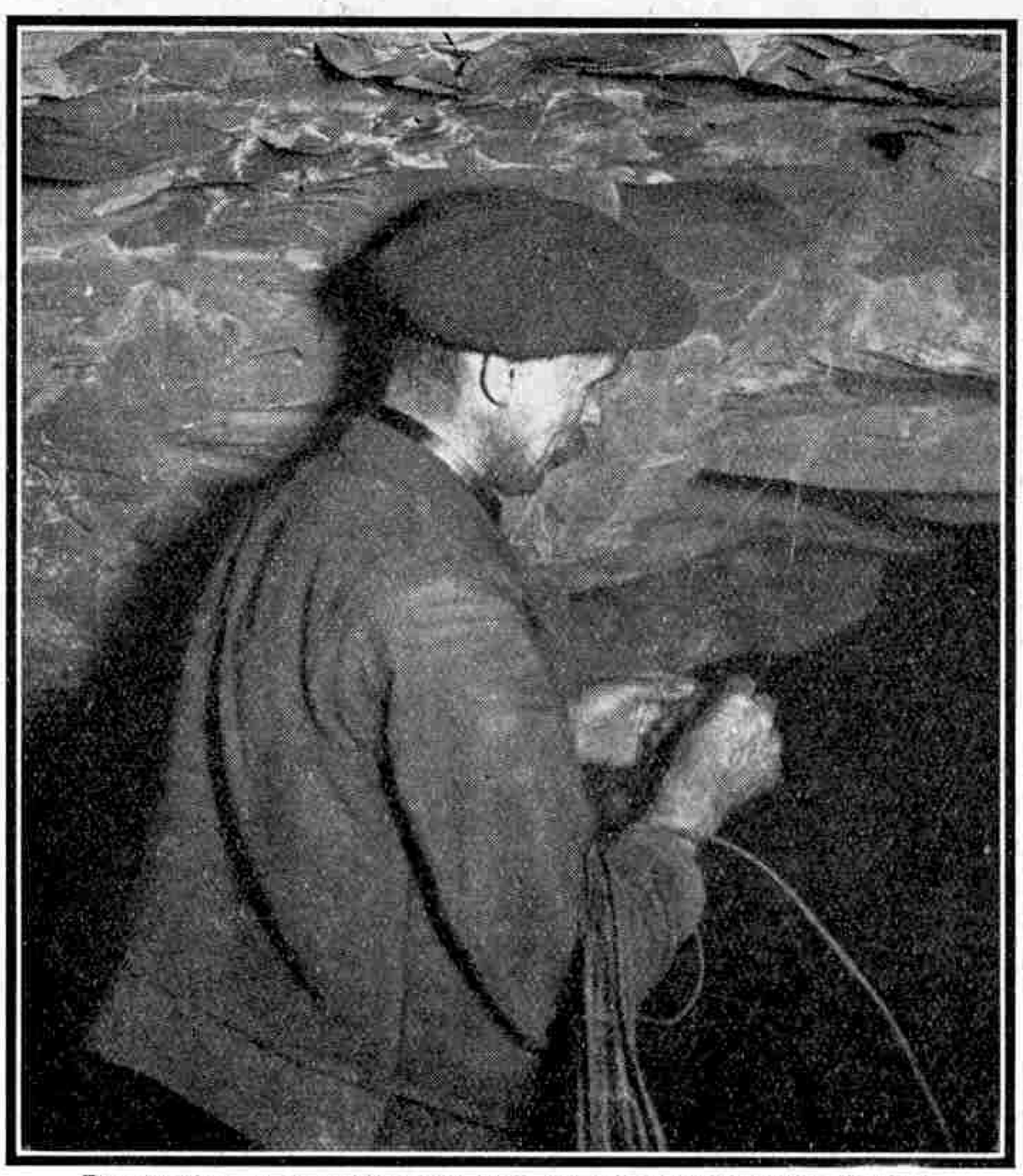
LAST month we dealt with the history of coal mining and the operations involved in establishing a mine. We come now to the actual methods employed to cut the coal and bring it to the surface.

The two principal systems by which coal is mined in this country are known as "pillar-and-stall" working and "long-wall" working. The former method is usually adopted for exploiting coal seams that are more than 7 ft. in thickness, and the latter for dealing with thinner seams.

"Pillar-and-Stall" Working

In pillar-and-stall working narrow roads termed "headings" are hewn out of the coal at right angles to the main roads. All coals other than anthracite, which is extremely hard, have cleavage lines, or planes, along which the material can be very easily split, and roads cut in the direction of these planes are termed "ends." These are generally more difficult to work than roads driven across the lines of cleavage, the latter passages being called "bords."

Headings are driven off from the main roads about 100 yds. apart. The coal on each side of the heading is so cut away as to leave stout pillars of coal each about 20 ft. square to support the roof. When a heading has been driven to the full extent of the coal seam, and all coal except the pillars has been "stalled," or removed, the miners commence demolishing the latter, beginning with those at the extremity of the heading and working back to the main road. Sometimes, however, it is found impracticable to remove the pillars, and a considerable quantity of coal has then to be left behind.



Deputy connecting up the wires from his pocket battery with explosive

"Long-Wall" Methods of Operation

The headings of mines worked on the long-wall system are driven off from the main roads at an angle of about 45°, instead of at right angles as in the case of pillar-and-stall working. Narrow cross-roads called "gates" are then cut from the main road to the heading. As operations proceed farther from the point where the heading branches off from the main road, the cross-roads increase in length. New headings are driven off from the gate and from these other short cross-roads are opened up.

A heading and several gates having been opened up, mining is commenced, one miner beginning at the junction of main road and heading, while others simultaneously work on the coal face along each cross-road. Operations are carried forward until ultimately the coal is cleared out up to the gate ahead. Waste material, or "goaf" as it is called, is stacked up at the rear of operations. Communication passages necessary for the circulation of air, trucking of coal and convenient access to workings are left through the goaf.

Sometimes the direction of working is reversed, and what is known as "long-wall retreating" is carried out. Narrow headings are driven through to the full extent of the coal seam, and the working of the coal in the form of a long-wall face is commenced at the far end, operations being gradually brought forward to where the heading began. The goaf is heaped up behind the workers as in the ordinary long-wall working, but as there is no more coal to be got out of that part of the workings no passages are left in the waste heaps. The temporary roof props are withdrawn and the stratum above in time settles down upon the waste heaps. This sinking of the upper stratum manifests itself above ground in the form of subsidences, and often brings about the ultimate collapse

of buildings that have been built on that area.

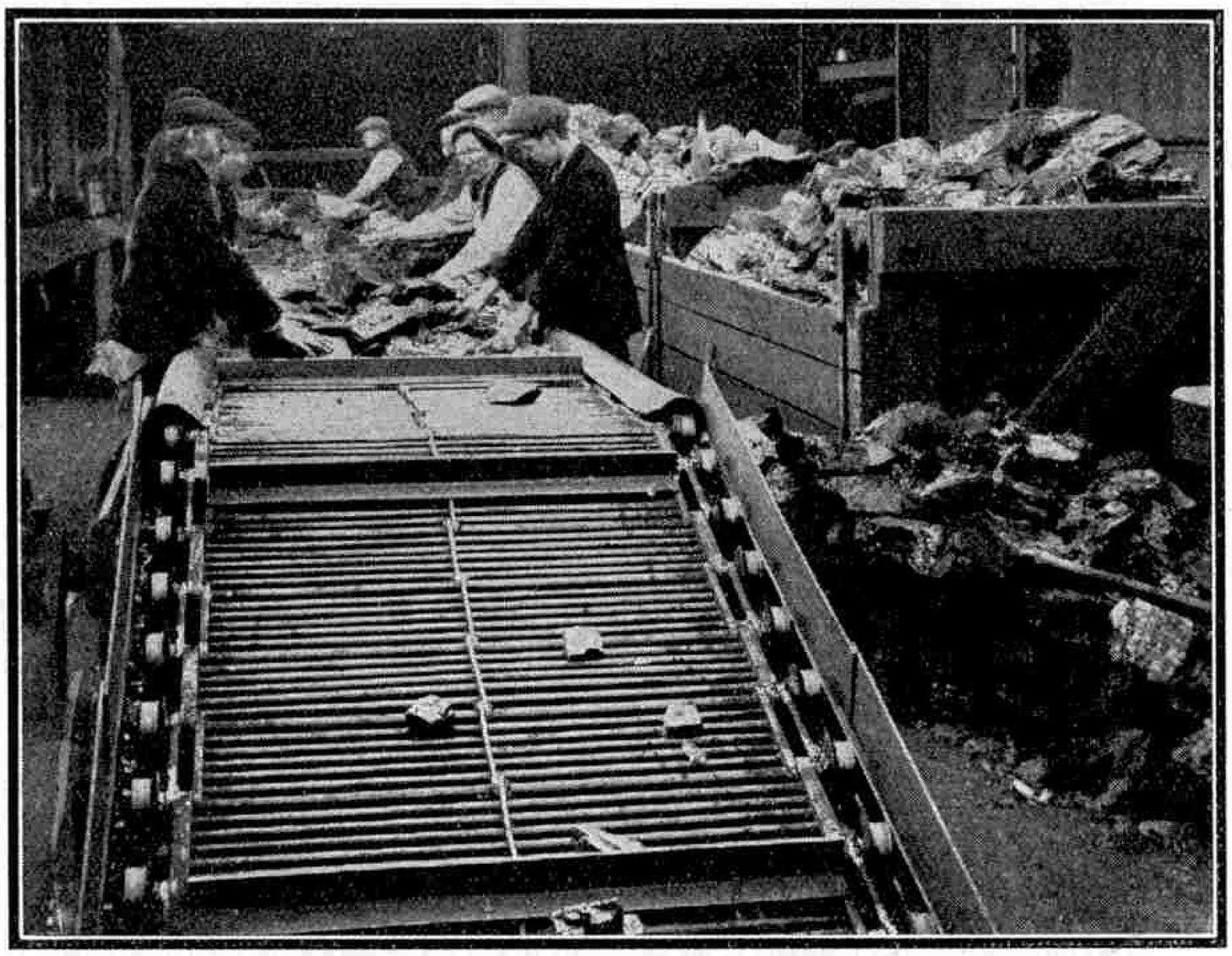
Long-wall working varies considerably in different mines, as differing conditions necessitate various modifications or changes in the system.

Timbering a Mine to Ensure Safety

One of the most vital factors in mine safety is adequate timbering and propping of the workings, and an amazing amount of wood, practically all of which has to be purchased from abroad, annually finds its way into the coal mines of this country. Although the miners themselves do a certain amount of roof-propping at the point where they are working, special timbermen are employed by the mine-owners to carry out the propping of main roads and headings. A constant watch is kept for the slightest sign of a weakening support and when one is detected it is immediately reported and replaced by a sound timber.

The strengthening of road sides and supports of roofs is carried out systematically by the timbermen. At frequent intervals along these underground thoroughfares stout wooden posts are erected against the walls and a cross beam is tightly wedged between their tops and the roof. At the junction of roads, and at other places where the roof requires additional support, a "cog" is usually erected. This consists of four stout vertical posts so placed as to form the corners of a square, the interior being then built up solid with stone.

Where very heavy pressure is exerted upon the timber supports, a prop will sometimes show signs of splitting after having been in use little more than a day. In a number of mines, steel props and roof bars are now installed at all "bad" places.



Experienced men sort the coal

Miner's Hazardous Work

The first operation in the actual mining, or "getting" of coal, whether by the pillar-and-stall or the long-wall method, is that of hacking out a long cavity at the bottom of the seam, preparatory to dislodging the mass above. The cutting of this deep slit, which generally extends for five or six feet into the seam, is known as "undercutting," and when carried out by hand it is one of the most hazardous and exhausting tasks in coal mining.

In commencing undercutting, which is usually effected along the joining of the coal seam with the floor of the stall or working, the miner has to adopt a kneeling posture to wield his pick. The discomfort of working for long in this extremely cramped position can well be imagined. As the pick eats its way into the seam and the dark cavity increases, the miner has to get down still more, and by the time the undercut is completed, many hours later, he is well underneath the huge mass of coal left untouched. This coal is supported by short props termed "holing sprags," and if these prove unequal to the tremendous strain imposed upon them, the unfortunate miner is crushed beneath the fall of coal that inevitably takes place.

When the undercutting is at length completed, the miner crawls from his working place and, after knocking away the sprags, loosens large blocks of coal by hammering wedges into the unsupported mass.

If the coal is of a hard, unyielding character, more drastic measures are taken to dislodge it. A narrow hole is made in the seam and charged with explosive. The greatest care is exercised in deciding the nature of the explosive to be employed, and in 'fiery' or 'dusty' mines some flameless high explosive is used. Gunpowder is only adopted in wet mines, where no gas is present. The charge is fired by connecting the wires to dry batteries, as shown in the photograph on the previous page.

Increasing Use of Coal-Cutting Machinery

Coal-cutting machines, driven either by electricity or compressed air, are very largely used in the coal mines of the United States, and are becoming increasingly adopted in this country. There are several types of machines, but we have only space here to describe the most interesting.

As in the case of boring tools (described in last month's "*M.M.*"), coal-cutting machines are made in two classes—those for percussive working and those for rotary working. The "heading" machine for percussive work is an adaption of the percussive drill and can be used for drilling as well as undercutting. The machine is attached to some vertical stand and can be adjusted to undercut the coal seam at any desired level. Moreover the cutter can be swung round or tilted as required.

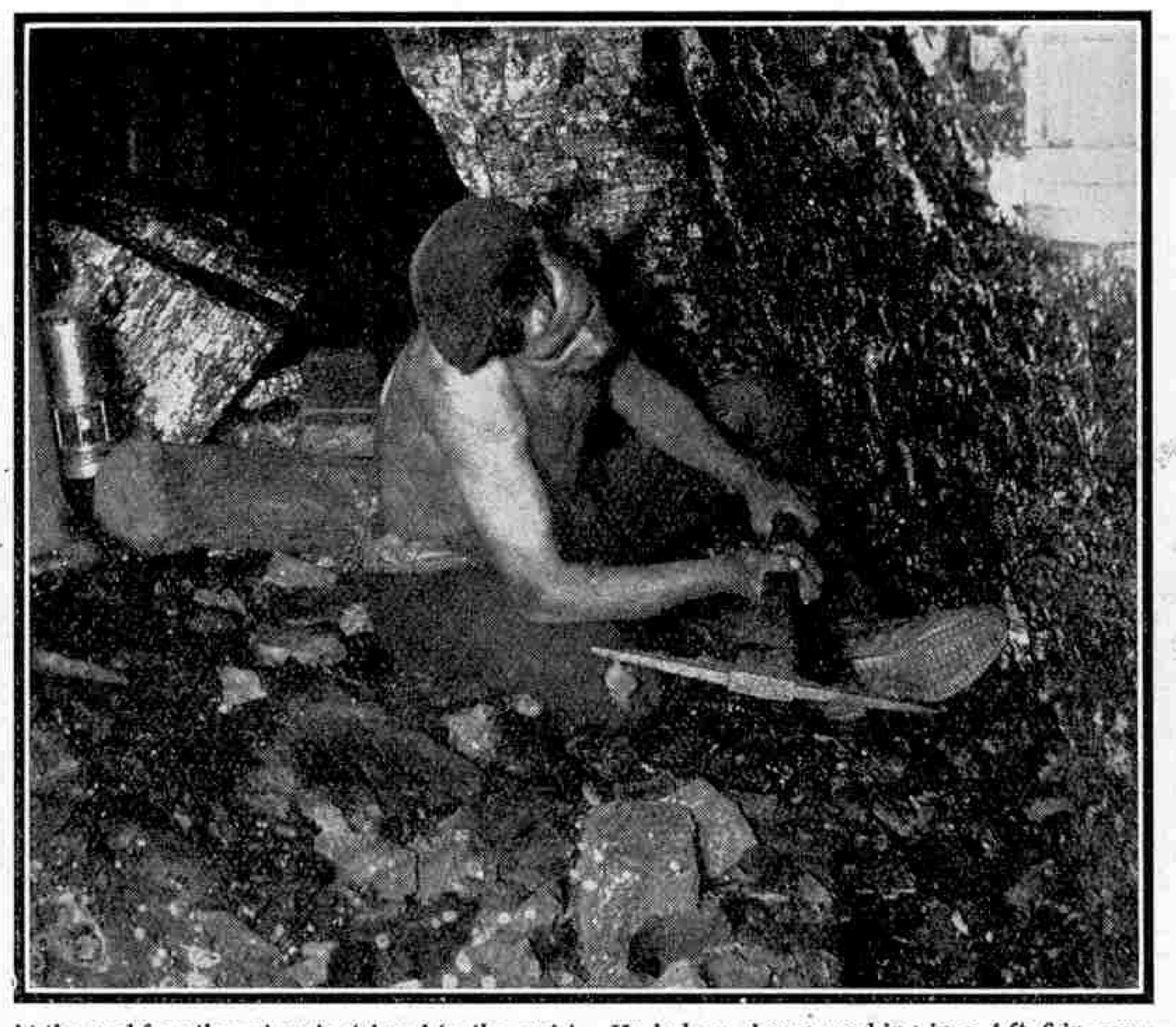
The range of the cutter at a single setting can effect in a coal seam a cavity as much as 12 ft. in width and 5 ft. or 6 ft. in depth. Percussive machines are not used for long-wall working, for which purpose all the principal types of rotary machines are suitable.

In chain rotary cutting machines the cutting tools are set at intervals on an endless chain working round in the groove of a jib about 1 ft. in width and $1\frac{1}{2}$ ft. in length, which projects from one end of the machine. The jib is movable and can be adjusted to any angle within its semicircular range of movement. It is drawn

along the coal face and can undercut to a depth of about 4 ft. working close up to the face. These machines so far have not been largely used in this country, disc machines having been employed with greater success.

The cutting tools of disc rotary machines are fixed to the rim of a horizontal disc about 6 ft. in diameter. When the machine is in operation this disc revolves, causing the teeth to cut a narrow groove out of the coal face. As cutting proceeds, the machine, which is erected on flat steel skids, imparts forward motion to itself through a small haulage gear at one end of the machine frame.

The adoption of mechanical means of undercutting the coal is not looked upon with favour by the miner. But although the machines are very heavy and awkward to move about in narrow stalls or headings, they can nevertheless undercut the coal without human life being endangered in the process, and this is certainly a very important consideration.



At the coal face the miner is stripped to the waist. He is here shown working in a 4 ft. 6 in. seam

Mechanical Conveyors

Where undercutting and dislodging of the coal is done by hand, boys working along with the miners shovel the coal out into the headings, where it is loaded up into tubs to be hauled away. Such a method of dealing with the loosened matter is totally inadequate, however, where coal-cutting machinery is adopted, and mechanical conveyors are installed to cope with the output. There are several types of conveyors. Some of them consist simply of a metal receptacle or carriage that can be mechanically drawn across the coal face by means of a rope. Others consist of a sort of steel trough erected in sections along the coal face. Inside the trough works an endless chain, and this carries the coal along and finally discharges it into waiting wagons or tubs, ready to be hauled to the shaft bottom.

Hauling Without Pit Ponies

While mechanical conveyors are doing away with the loading of the tubs by hand, mechanical methods of haulage are likewise gradually eliminating the need for pit ponies. This latter change is one that no one can justly regret. The average term of a pit pony's service underground is about nine years, and during that period he is rarely brought to the surface to enjoy a spell of joyous freedom in the open fields. To pit ponies the prolonged coal strike last year was an undreamed-of blessing!

It is less than a century since coal was being carried from the coal face to the shaft bottom in baskets slung on the backs of women and children. When this deplorable method was prohibited by law, the use of tubs drawn by hand or horse along wooden rail-tracks was adopted. In time the wooden rails gave place to wrought iron track, which in turn was abandoned in favour of the steel rails common in coal mines to-day.

The size of tub used and the gauge of track adopted vary in different districts, the capacity of the former depending partly on the expected yield of coal from the seams, while the dimensions of the tub in turn decide to some extent the gauge of the track.

In the Midlands and Lancashire coal mines the capacity of the truck used varies from 6 cwt. to 12 cwt., while in the Tyneside and Durham area trucks up to 15 cwt. are adopted. In the South Wales districts considerably larger vehicles are installed, holding almost a ton-and-a-half of coal.

Mechanical haulage is now adopted in all up-to-date collieries, and where the main road to the foot of the shaft is wide enough, a double rail track is laid, enabling loaded tubs to be drawn in on one line and "empties" returned to the headings on the other. Close to the base of the shaft is a shed containing the haulage engine, worked by electricity fed to it by cables passing down the shaft-side from the surface power house.

Where a double track is available the endless-rope system is often used to work the traffic. The rope passes from the driving pulley in the underground engine shed to the termination of the haulage road, where it passes round a pulley attached to a tightening carriage and comes back to the driving pulley. The rope is sometimes arranged to pass over the tubs, and sometimes under or along the side. Loaded or empty tubs are attached either singly or in trains, and motion is limited to the slow speed of three miles per hour.

In the United States specially-designed electric and compressed air locomotives are in common use for coal mine haulage work. The latter were tried out in England about 40 years ago, but were unsatisfactory, and although improvements have since been made in their construction they are not as yet common in British collieries. In Germany and France mine locomotives equipped with internal combustion engines working on benzole, petrol or methylated spirits are in general use.

Surface Operations

At the base of the shaft the tubs are run into the cage, generally two tubs side by side on each floor, and whirled to the surface, where they are run out on to a slightly inclined track down which they travel by their own weight to the weighing machine. There each tub is carefully weighed and the quantity of coal it contains booked by the weighman to the credit of the miner who filled the tub and chalked his number on the side. The practice of chalking the loader's number on a tub has sometimes led to acts of dishonesty, but to have tubs marked with permanent figures would cause great confusion in endeavouring to return to each miner the same tubs.

From the weighbridge the loaded tubs are pushed to the foot of an inclined road laid out with a double track. At the foot of the slope the front axle of the tub is hooked by one of the projecting catches of an endless creeper chain moving up the centre of the track. The chain draws the tub to the top where it is caught by a man and run over to a "tippler." In the tippler the tub is locked and swung round, the coal being emptied on to screens below. This method, known as "side-tippling," is shown on page 399. The empty tub is returned to the incline where, on the other line, it is hooked by a creeper chain moving downward and is thus prevented from running away. On reaching the foot of the incline it is conducted to the pithead for return to the workings.

The screen consists of an iron trough or pan, the bottom of which is covered with a wire mesh or perforated iron plate. By means of eccentric rods operated by a small engine the screen is given a rapid to-and-fro movement which, together with a slight inclination of the screen, causes the coal to travel slowly along. The size of the mesh or perforations in the bottom of the screen depends upon the size of coal required. If, for instance, four sizes are wanted, each screen is fitted with three sets of openings of different sizes, the smallest size being at the upper end and the largest at the lower. Thus, in descending, the coal is sorted out rapidly and efficiently.

After screening, the coal falls on to endless travelling belts which convey it to an adjoining room where fireclay and other inferior material is picked out by men, women, and boys ranged at intervals along each side of the belt. These belts are made up of iron plate about 3 ft. in width and they travel at a speed of from 20 ft. to 50 ft. per minute.

The small coal and fine dust are separated by washing with water in special troughs called "jiggers." These jiggers are agitated mechanically in a similar manner to the screens. The heavy impurities sink to the bottom, while the coal is washed over into another receptacle, drained and carried by bucket elevator up to storage bunkers into which it is tipped. From the storage bunkers the coal is conveyed, in due course, into railway wagons and despatched to the required destination.

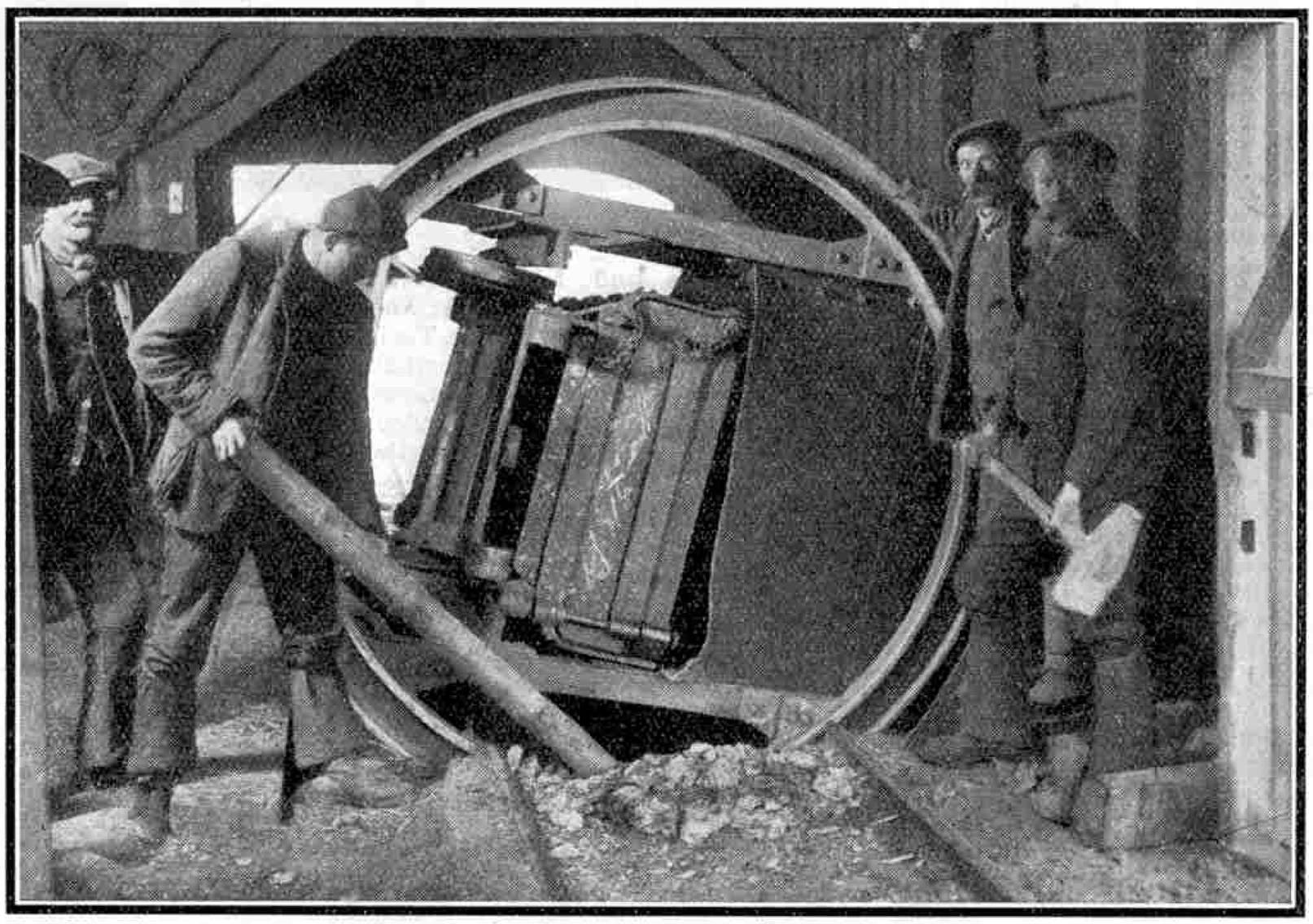
The fine coal dust retained by the "jigging" plant was for a long time regarded as useless and accordingly was sent to the

waste dump. Now, however, it is utilised profitably to make briquettes and in the manufacture of coke.

Daily Perils in Coal Mines

Despite the many modern safety devices and the great strides made in perfecting mining machinery, the miner's work is by no means free from risk. The majority of the accidents that occur are due to falls of roof. Often a considerable time elapses before it is possible to clear a stall or heading and release the unfortunate men buried by the black avalanche, and sometimes the rescuers are too late. Collapsing pit props or roof bars have been known to fall and wedge themselves in such a manner as to protect the miner beneath from the mass of debris above the prop.

One of the most terrible dangers confronting the miner is that which arises from the gas that escapes from the coal into the air of the mine. This gas consists mainly of methane, or marsh-gas, and it explodes violently on coming in contact with a flame. In mines where gas is prevalent it is obviously impossible for the miners to use any kind of naked light, but on the other hand they cannot work in the dark. The problem is solved by the use of the safety lamp, which was invented by Sir Humphrey Davy in 1815. George Stephenson is stated to have hit upon the same principle about the same time.



Miners tipping coal from trucks at Bargoed Colliery near Cardiff

The modern safety lamp is about 10 inches in height. The air container and the wick are enclosed in a glass cylinder protected by four upright brass bars placed at equal distances apart. A circular piece of fine wire gauze forms the roof of the glass and is in turn protected by a metal shield fitted with a hook that enables the lamp to be carried or hung up. The safety feature of the lamp lies in the gauze screen. The holes in the gauze allow the entry of the air that is necessary for combustion, and if any gas is present it enters along with the air and is burned. On the other hand, the flame cannot pass through the gauze, and therefore cannot come in contact with the gas outside the lamp and thus cause an explosion.

The miner does not clean his own lamp but hands it in at the lamp room at the surface when he comes off duty. The lamp room has a staff of boys who manipulate lamp-cleaning machines, which effectually do their work by means of electrically-operated brushes. The boys also light the lamps for miners going down the pit, using for the purpose an electric spark. After it is lighted the lamp is locked before being handed to the miner, and it cannot be opened except by a special appliance in the lamp room.

An explosion of gas not only causes immediate loss of life but also it gives rise to another gas known as "after damp" which consists mainly of carbon dioxide. This gas is not explosive but if breathed causes death by suffocation, and to guard against it special gas masks are worn by the rescue parties when descending a pit in which an explosion has occurred.

Another peril found in wet mines is that of "hidden water." It sometimes happens that the extending workings draw near to some deep pool, and when the resistance of the adjoining earth decreases to a certain point the water bursts through into the mine and pours into the workings, sweeping everything before it. The miners then have to run for their lives, their only chance being to reach the higher workings. Frequently the men are trapped at the top of the heading by the rising flood, and days may pass before the rescuers are able to cut a new passage to the heading and release both men and water.

The World's Coal Supply

The question is often asked: "How long will the world's supply of coal last?" Although the total annual consumption is tremendous, and present day methods of mining and usage are mostly very wasteful, the earth's resources of coal are so prolific that there is little fear of supplies giving out before the world has generally adopted other sources of power, such as oil and hydro-electric power.

The earth's coal resources have been variously computed. One estimate places the total at 600,000,000,000 tons while another declares it to equal in extent fully 500,000 square miles. Great Britain's share of this latter figure is represented at less than 10,000!

Almost half the world's supply of coal has been estimated to underlie the United States and the coal measures of that vast country are reckoned as totalling 200,000 square miles! This impressive figure includes two great coalfields each of 60,000 square miles. Various grades of bituminous coals comprise about three-quarters of the United States coalfields, the remainder being lignite and anthracite formations.

Canada is also rich in coal, the deposits there being computed at 172,057,000,000 tons. Considerable coal-bearing areas are as yet unavailable as the seams extend far under huge forests. Australia also possesses substantial coal deposits, the Queensland coalfield extending over 24,000 square miles.

The famous Bavarian coalfields of Germany include coal measures totalling 20,862 ft. in thickness—a depth unrivalled by any other coalfield as yet discovered. Mention must be made also of China's considerable deposits, and in the neighbourhood of Pekin coal seams with an aggregate thickness of 90 ft. have been worked for many years. France, Italy, Spain and Russia all contain coalfields in smaller degree, while on the continents of Africa, India and South America vast areas still await the prospector before their mineral wealth can be adequately calculated.

Coalfields of Great Britain

Of the several large coalfields in Great Britain the most important is that of South Wales, covering an oval-shaped area 50 miles in length by 18 miles across at the broadest part. The Welsh steam coal is world-famous, and is exported in huge quantities annually from Cardiff, Newport and Swansea. It is practically smokeless, and by reason of its splendid heating qualities has long been a favourite for use in marine boilers.

The thickest coal seam in the United Kingdom is the "Ten Yard" seam in the South Staffordshire coalfield. It comprises a bed of almost clear coal, reaching in places to a depth of 30 ft.

The Durham coalfield is noted for its yield of an excellent house coal popularly called "Wallsend"—a name derived from the locality of the ancient and now disused pits from which this class of coal was first mined. These pits were situated in the neighbourhood of the eastern termination of the famous Roman wall.

There are also important large coalfields in Lancashire and Yorkshire, that of the former county underlying an area roughly 52 miles by 19 miles. In the Wigan district, where the coal seams number about 18, considerable quantities of cannel coal are mined.

In Scotland there is a 90-mile coalfield in the area from the Firth of Clyde to the Firth of Forth. The coal measures are somewhat broken up however. Comparatively little coal mining is done in Ireland, although last year a new colliery, equipped to handle 1,000 tons per day, was opened in County Tyrone.

NOTES FROM THE ZOO

A Zoo Afloat

On a recent occasion livestock consignments to the value of £3,000 were shipped from Liverpool for New York in the White Star liner "*Baltic.*" Five hundred canaries, some crates of racing pigeons, 15 greyhounds, and several pedigree dogs were included, and readers will be interested to learn that this country carries on a large export business in pedigree stock of this kind. In addition the consignment included 38 West African crown cranes, five Australian wedge-tail eagles, four Australian cassowaries, two condors, three demoiselle cranes, and three Manchurian cranes, all destined for the New York Zoological Park.

Special accommodation was prepared for the animals and birds. The 38 West African cranes, the biggest shipment of the kind that has ever left Liverpool, were housed in a large airy room, where they were free and could exercise at will. The remainder were in spacious crates and kennels set round the walls of another large apartment of the liner, and care was taken that the dogs were given exercise along the open deck each morning and evening of the voyage.

* * * *

An African Elephant tries to Escape

An African elephant of the New York Zoological Gardens lost patience recently and decided that the time had come to leave his restricted quarters. He had first, however, to move the massive steel bars of his cage. Fortunately his effort proved a failure, but not before he had proved his immense strength.

When the mighty trunk started work on the large girders they were bent with great ease, while the small rails and bolts were snapped and hurled about like straws. After this exhibition the authorities decided that a cage twice as strong was necessary for the future.

* * * *

Full Grown Wart Hog

A recent arrival at the London Zoo is a fine adult specimen of the wart hog. There have often been young wart hogs at the Zoo, but now for the first time visitors are able to see what the full-grown animal is like.

Bill, as this latest arrival is called, resembles the ordinary pig in most ways, but his tusks are much bigger and more formidable, and the curious warts on the side of his head, which give him his name, are very prominent. On the ship that brought him to England he became a great favourite, and now he greatly appreciates the value of human friendship.

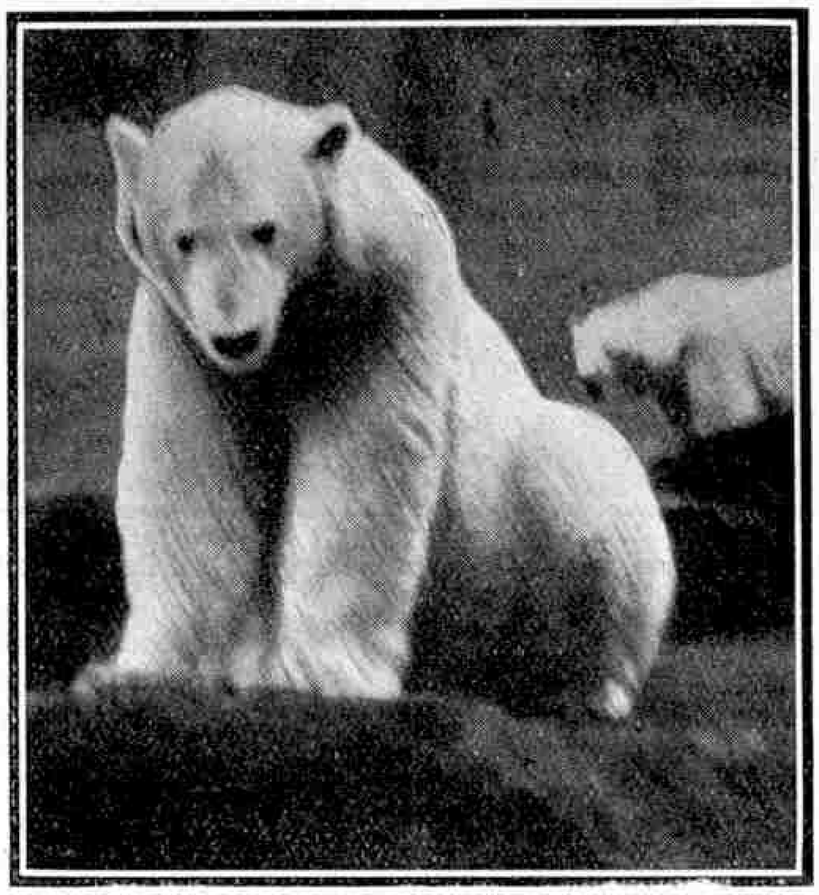
The Chimpanzees' Tea Party

Clarence, Jimmie and Bibi are only babies, but Jackie is four years older and is quite a grown-up chimpanzee. Their education has now reached the stage when they can be relied upon to behave nicely at their daily tea parties in the London Zoo.

After they have taken their seats at the table, each has a good long drink of milk, and then Jackie hands round the plate of food from which the younger apes help themselves in the most polite fashion, without any grabbing or quarrelling. From time to time the keeper calls Jackie's attention to the fact that his friends have nothing to eat, and once more he passes the plate round. Another cup of milk ends the meal, and then Clarence and Jimmie wait while Jackie helps little Bibi down from her chair.

Jackie is developing in remarkable fashion. He has now learned to collect the crockery and hand it to the keeper and also to take the younger chimpanzees to bed. About this latter business he shows great firmness, ruthlessly bundling each of the others into their sleeping boxes and shutting the doors on them, but when the time arrives to put himself to bed this firmness disappears. He appears to find difficulty in opening the door of his own box, and even when he has managed to open it he has the greatest trouble in climbing inside.

The chimpanzee is generally regarded as the most intelligent of all animals and the success of this experiment at the Zoo tends to confirm this. Enamel plates and cups have to be used, but this is only on account of a tendency to clumsiness that the animals show at times, as all four behave extremely well. Jimmie has the best table manners, but Jackie is the "star turn" and is the only one who can be persuaded to offer food to his companions.



"I'm not very well this morning!"

A Snap of a Polar Bear taken at the Zoo by J. G. Cheshire

* * * *

Cages for Eagles to Fly In

The Zoological Park at Corstorphine Hill, Edinburgh, was only opened in 1913, but has already proved itself a great scientific and financial success. It is designed on modern lines. Where possible deep ditches and other natural obstacles are used instead of the iron bars usually met with in such institutions, and generally the captives live under excellent conditions.

A scheme has now been proposed for extending the Park somewhat on the lines of that put forward in connection with the London Zoo. It will not be necessary in this case to go further away from the city, as there is plenty of available space adjoining the present grounds on the outskirts of Edinburgh. Further, the ground is very suitable, and ranges for bison and deer, rocky dens for lions and tigers, and a sheltered valley for the more delicate animals will be easy to plan. The promoters even contemplate the construction of cages sufficiently large to show eagles in flight!

The project will cost £25,000. A national appeal for funds is being made by the Scottish Zoological Society, who own the park, in order that the construction may be commenced immediately. If the money cannot be raised in this manner it will be necessary to wait a long time for the completion of the scheme, as the only other method possible is to pay for it out of the annual profits.

* * * *

Fly Hatchery at the Zoo

There are many strange things to be seen at the London Zoo but one of the strangest is certainly the fly hatchery in the reptile house. Here "gentles" are kept in warm surroundings and fed on moist bread, treacle, and meat until they develop into flies which are allowed to multiply. They are required for feeding the frogs and lizards, of which the Zoo possesses a large number. The latter must earn their living by catching their own food, for the flies are caught in a special wire trap and then released in the cages of the reptiles.

Falling an Inch in 2½ Months

Wonders of the Movements of Minute Particles

IT would scarcely be thought that such a simple process as dissolving salt or sugar in water would offer any difficulty to scientists who are capable of determining the weight of the earth, and even the size and composition of stars millions of miles away. But simple processes like these have a way of disclosing difficulty after difficulty on further examination.

It is well known that powdered granite, if placed in a vessel of water, simply settles to the bottom, while salt in the same circumstances disappears from sight or dissolves, provided that we do not put in too much of it. Why does the granite also not disappear from sight, and what happens to the salt when it does disappear ?

To the first of these questions we are not going to attempt to give an answer. With regard to the second there seem to be two possibilities—either the particles of salt have simply mixed with the particles of water or some kind of combination has taken place between the two. Many substances that dissolve, such as soda and nitre, form crystals containing a large proportion of water, so that at first glance it appears as if some kind of combination has taken place in solution. On the other hand salt forms cubical crystals that do not contain water, and further, the proportion of salt and water in a solution may vary within wide limits, while the essential feature of a compound is its consistency of composition.

For practical purposes, therefore, we may assume that when salt or any other soluble substance is added to water the two are simply mixed, and we may picture the tiny particles of the salt as intermingled with those of the water. In addition it seems to be quite clear that the particles of salt are continually in movement.

Fig. 1. How the layer of water is added to the blue vitriol solution without mixing. Pouring down the glass rod prevents splashing

How Solid Particles Move in Solutions

A gas always spreads out to fill all the space available, and exactly the same thing happens with salt or any other substance dissolved in water. This may be proved quite easily by a simple experiment with a coloured substance, such as blue vitriol, which can be bought from any chemist—an ounce will go a long way. Powder some of the blue vitriol and put it in a glass half full of water, stirring well until a deep blue solution is obtained. Now allow water to trickle very slowly down the side of the glass until the latter is nearly full. If this operation is performed with sufficient care there will be a distinct line of separation between the blue solution and the clear water above it. Another and perhaps easier method of doing this is to pour the water gently on to a flat piece of cork floating on the blue vitriol solution. The cork must not be removed after adding the water, as this would probably mix up the two layers of liquid.

It is easy to see that the blue vitriol will now have a free space into which it may spread, and on leaving the solution for some time it will be found that the surface of separation has become indistinct, the blue colour spreading into the clear water at the top. Eventually the whole of the liquid will be found to have the same colour.

This can be explained only by supposing that the small particles of blue vitriol move about among the water particles in the same manner as the particles of a gas move about, and that they are thus able to penetrate into the clear water in the upper half of the glass. The particles of liquids are much more tightly packed together than are those of a gas, and in consequence this movement is not very rapid, nor can the particles of the blue vitriol move very far in one direction before colliding with particles of the water and being turned aside. In the experiment just performed the blue vitriol particles do not rush into the extra space at anything like the speed with which the particles of air rush into a vacuum.

This slow movement is exhibited by all substances that dissolve in water, and is called " Diffusion."

Diffusion will take place into jellies. To show this, make a small jelly in a vessel about the size of an egg-cup, by dissolving gelatine in water. Powdered gelatine may be dissolved immediately in hot water, but ordinary gelatine should first be soaked in cold water until it swells, and the jelly when set should be stiffer than an ordinary table jelly. Now put the jelly into a solution of blue vitriol, and it will be found that the blue coloration will make its way into the jelly in the same manner as it did into the water, proving that the particles of blue vitriol have diffused into the watery gelatine.

It is possible also to obtain diffusion through a parchment membrane. The parchment paper used by provision merchants and butchers will do very well for this purpose. Twist a sheet of this up to form a bag and, after wetting it, pour in some of the solution of blue vitriol and then hang the bag so that the bottom of it dips into water in a basin. The water on the outside of the parchment bag will slowly acquire a blue coloration showing that diffusion of the blue vitriol is taking place through the membrane.

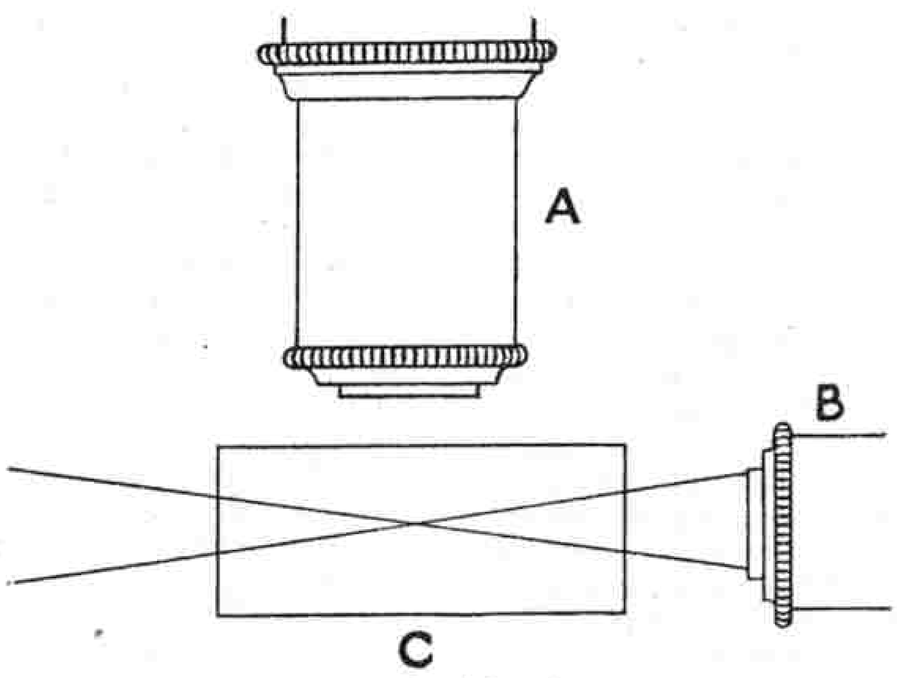
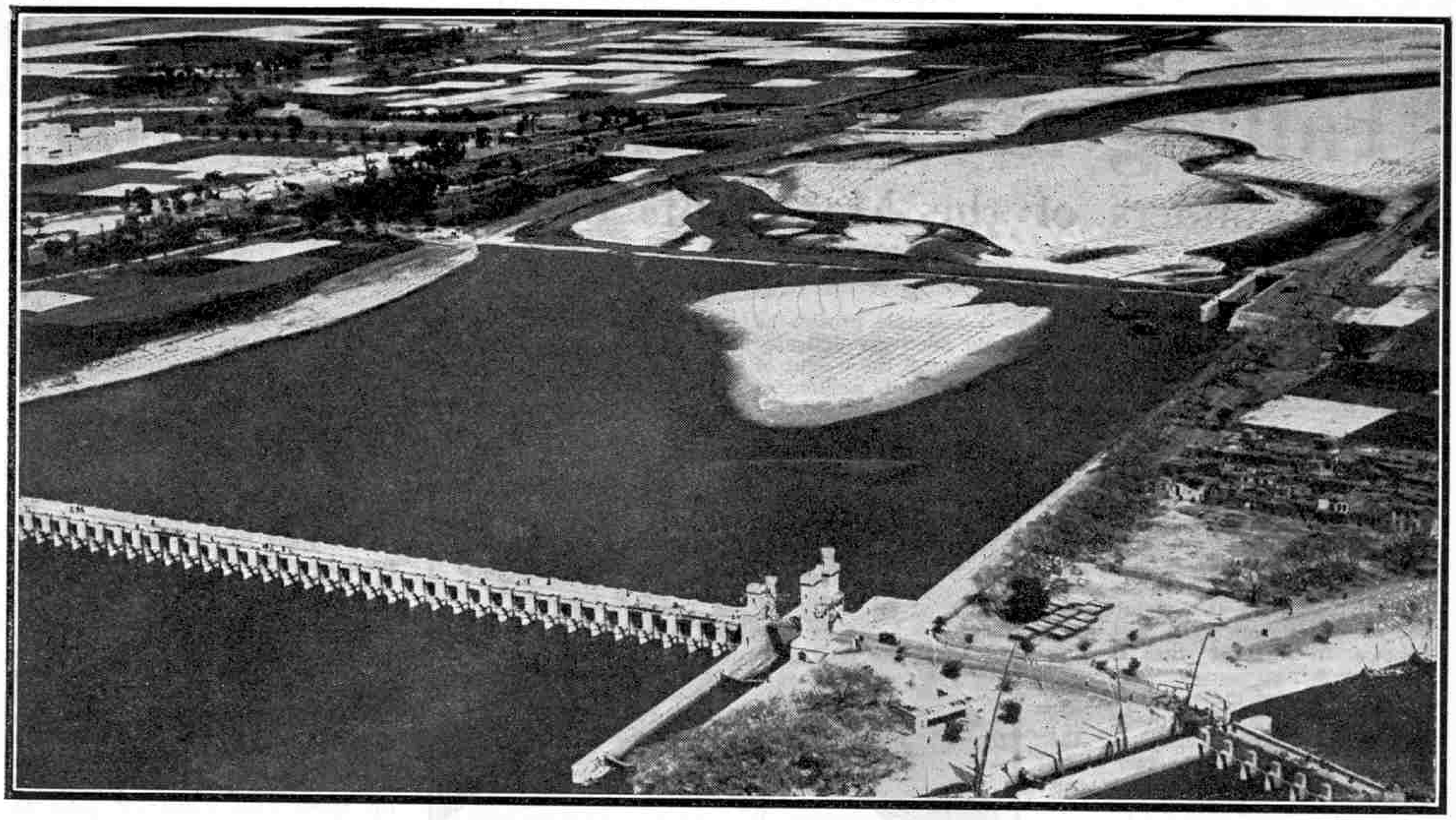


Fig. 2. The principle of the ultra-microscope

Simple Apparatus for Diffusion Experiments

Any piece of apparatus used for diffusion through a membrane is called a "*dialyser*," and a more convenient form than that just described can be made very easily from one of the round cardboard boxes used for holding cheese. To turn the box into a dialyser, cut out the circular portion of both the box and the lid. Stand the cardboard ring thus obtained from the box on a sheet of parchment about an inch larger all round, fold the latter over the cardboard ring, and put on the remains of the lid to hold the paper in position. The parchment paper is not very thick, so that the lid should fit tightly. A piece of string tied round will make a good substitute if for any reason



Air View of the Delta Barrage on the River Nile

The photograph clearly shows the mud flats formed by the action of the salt water on the minute particles in suspension in the river water, as described in this article

the lid cannot be used. We now have a shallow drum with only one parchment surface and this, with liquid inside, can be floated on water in a basin or soup plate, the latter for preference as it is shallower.

With this simple apparatus it is easy to show that, besides blue vitriol, such common substances as sugar and salt will diffuse through the parchment, and their presence in the outer liquid may be recognised by their taste. Here, however, we come across a puzzle—there are many substances that will not diffuse through the parchment in the same way as salt and blue vitriol. Among these are starch and glue, and we can best realise the difference between the two classes of substances by another simple experiment with our dialysing apparatus.

Mix half a teaspoonful of starch into a smooth paste with water in a cup, and then fill the cup with boiling water, stirring meanwhile. Add enough sugar to make the liquid noticeably sweet, and after cooling pour some of it into the cheese-box float and place this in water. In order to trace what becomes of the starch and sugar we must have tests for each. In the case of the sugar, tasting the liquids will tell us all we want to know. The best test for the starch is the deep blue coloration it gives with iodine, the well-known liquid used so largely nowadays as an antiseptic, a bottle of which is to be found in practically all first-aid cases and family medicine chests. This test is familiar to many people as the one used to prove the presence of starch in potatoes. To use it here all that is necessary is to put a single drop of iodine on a clean plate and add a drop of the liquid to be tested, taking care to rinse the spoon or glass rod used after each dip.

Sugar Separated from Starch

At the beginning of this experiment the liquid in the float will be sweet and will give a blue colour with iodine, proving that it contains both sugar and starch, whereas the liquid on the other side of the parchment is water only. After a few hours the outer liquid will be found to be sweet, but will still give no blue coloration with iodine, showing that no starch has passed through the membrane. By continuing the experiment, and changing the water in the outer vessel frequently, the whole of the sugar may be removed from the solution in the float, leaving the starch behind.

Exhaustive experiments on similar lines to this were carried out by the eminent Scottish chemist, Thomas Graham, who was born at Glasgow in 1804 and died 1869. Graham graduated at the University of Glasgow and determined to devote himself to a scientific career in spite of the rather bitter opposition of his father, who wished him to become a minister. He became successively Professor of Chemistry at Anderson's College, Glasgow, and University College, London, and was the first President of the Chemical Society of London. In 1855 he succeeded Sir John Herschel as Master of the Mint, which post he held until his death.

Crystalloids and Colloids

As the result of his experiments in diffusion, Graham found that the substances that would pass through the membrane were usually crystalline in character, while those that behaved like starch and did not pass through the membrane were substances that did not form crystals. The former substances he called "*crystalloids*" and the latter "*colloids*." The word colloid is derived from the Greek *kolla*, meaning glue, and *eidos* meaning form, and Graham chose this name because all the substances of this type known to him were of a gluey character.

Graham's classification was not quite correct, however, as substances are now known that can be obtained in both forms. Thus gelatine, usually a colloid, has been obtained in the crystalline state, and on the other hand a colloid solution of salt has been made although salt is usually a crystalloid. To-day therefore these names are used to denote the condition of a substance, and not the substance itself.

The process of dialysing will be seen to provide a method for separating a crystalloid from a colloid and it is often used for the purpose of preparing colloids in the pure state.

Curiosity is naturally aroused as to why the particles of a colloid will not pass through the parchment membrane used in the above experiments. One obvious explanation is that these particles are larger than those of a crystalloid substance, and that the pores of the paper are too small for them to pass through. This is not a complete explanation, but in a broad sense it is true, and a colloidal solution or suspension is now distinguished from a coarse suspension on the one hand, and an ordinary solution on the other, by the size of the particles contained in it.

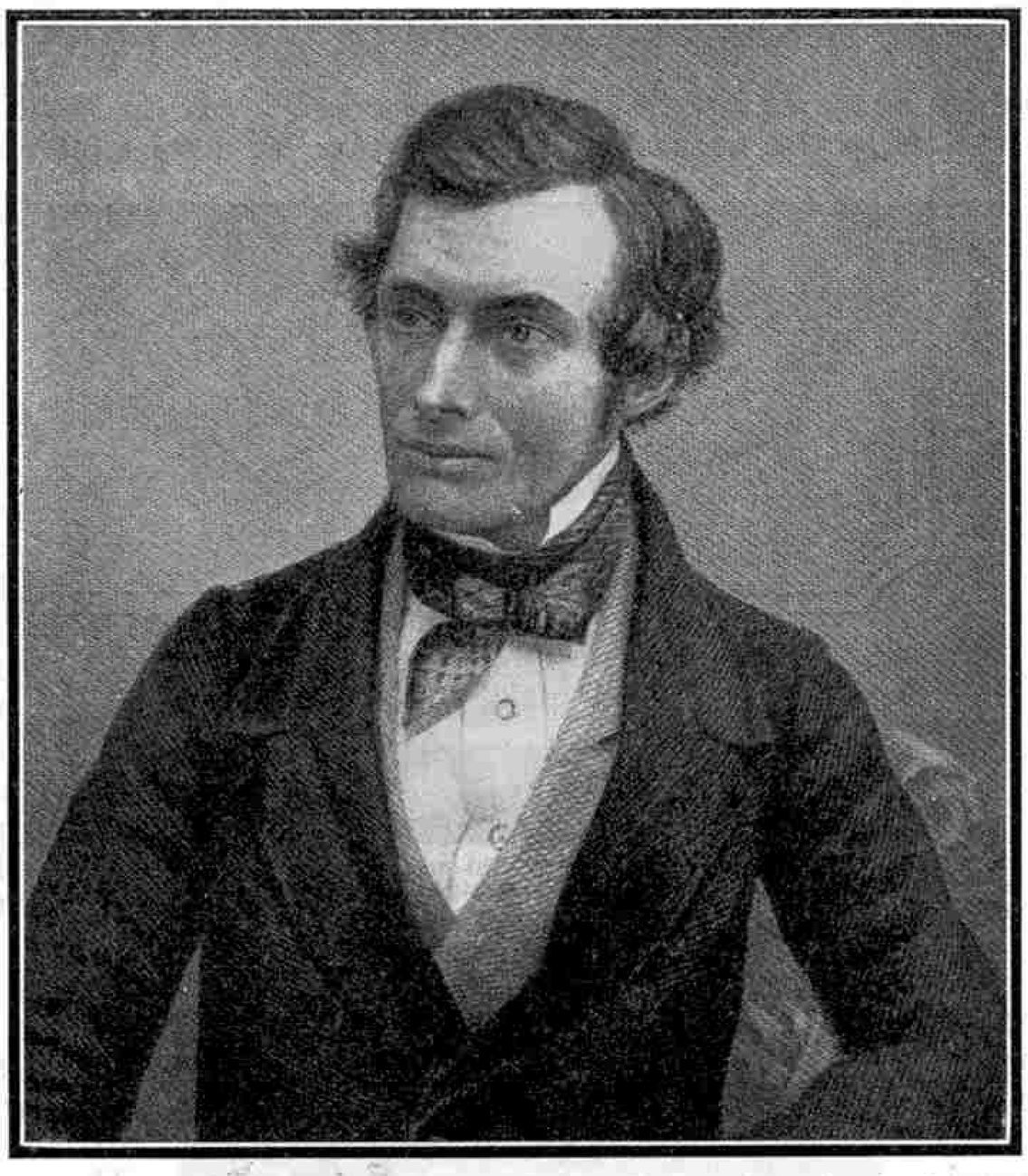
If the solid particles contained in the liquid are so great that no more than 250,000 of them can be packed in line within a length of one inch, then the mixture is regarded as a coarse suspension. If, however, more than 25,000,000 particles can be packed in this length, the liquid is an ordinary solution. A colloidal solution is thus one in which the diameter of the particles is between $\frac{1}{250,000}$ in. and $\frac{1}{25,000,000}$ in. Even the largest of these particles are far too small to be seen by even the most powerful microscope, the smallest particles visible by this means being about $\frac{1}{60,000}$ in. in diameter. Thus an instrument magnifying more than four times as much as this would be required to see colloidal particles!

Readers already will be asking how we know that these small

particles really exist, and many of them will be surprised to learn that not only is it quite easy to detect such particles, but that readers themselves have very often performed a similar feat. The air of a room is full of floating dust particles that are too small to be visible. If the room is darkened a little, however, and a ray of strong sunlight is allowed to enter, the path of the ray becomes visible immediately, being revealed by a cloud of dancing dust particles. What we actually see in these circumstances is not the particles of dust, but the light reflected from them, in the same way as we see the light from a star too far away to be itself visible.

This phenomenon of the reflection of light from particles too small to be seen is often referred to as the "Tyndall phenomenon," and any liquid or gas in which the path of a strong ray of light is not made visible in this manner is said to be optically empty. Ordinary tap water, by the way, is not optically empty, and a beam of light can be traced through it just as easily as a sunbeam through a darkened room.

Exactly the same thing happens with the tiny particles of a colloidal suspension. These particles that are too small to be seen in the ordinary way in a microscope can be seen by the light reflected from them if a beam of light is passed through the liquid containing them. Fig. 2 shows how this is done. The rays from a suitable source of light are concentrated by the lenses in the tube B, and projected through the quartz cell C, containing the colloidal solution to be examined. None of this light enters the microscope A, but light reflected from the minute particles may be detected, and the number of these particles obtained by counting the tiny dots of light visible against the dark background. No alteration is made to the microscope itself, but the addition of this device makes it now what is called an "ultra-microscope."



Thomas Graham, F.R.S., the eminent Scottish chemist who made extensive researches in colloid chemistry

Measuring the size of the particles is not a difficult matter either. All that is necessary is to count the number of particles as above in a special cell, the size of which is known, and then to find the weight of the substance in the colloidal solution in this cell. By simple division the weight of one particle can be obtained, from which the volume can be calculated by dividing by the density. Nothing is known of the shape of these particles, so it is generally assumed that they are spherical, and their diameter is calculated accordingly. The result thus obtained may not be absolutely accurate, but it is sufficiently so for most purposes.

Even the ultra-microscope has its limits, and if any particle is less than one five-millionth part of an inch in diameter, its presence cannot be detected by this method.

It should be noted that there are colloids in which the ultra-microscope reveals no particles at all. The colloids of this class are nearly all organic substances, that is, they are of animal or vegetable origin, such as starch, glue, and tannin, besides the gelatine already mentioned. They seem to contain globules of liquid instead of small solid particles, as in the case of the colloid suspensions. They are therefore similar to emulsions, and are called emulsoids.

It is interesting to realise the effect of the size of these particles in a colloid suspension. Particles of granite in water settle to the bottom very quickly, but the rate at which settling takes place is dependent upon the size of the particles. To see what difference the size of the particles make we may apply a formula that was worked out mathematically by Sir George Stokes, over eighty years ago. This was intended to give the rate at which rain drops fall through the air, but it is an extraordinary formula that has proved of great value in many unexpected ways, and one of these is in determining the rate at which solids suspended in liquids will settle to the bottom. So long as we are dealing with the same solid and liquid, the rate of falling or settling depends only on the size of the particles, and the effect of size can be seen from an actual example.

Falling an Inch in 2½ Months

The metal gold forms colloidal solutions quite readily, and these have been known since Faraday's time. Photographers can easily make them by adding one of their developing agents, such as hydroquinone or pyrogallol, to a solution of gold chloride, making sure that this latter solution is either neutral or slightly alkaline with ammonia. A bright ruby red liquid is obtained in this manner. If the particles of gold in this liquid were about $\frac{1}{25,000}$ in. in diameter, then their rate of falling, worked out by Stokes' formula, would be $\frac{1}{10}$ in. per minute, so that a layer of liquid one inch in depth would become clear in 10 minutes by the settling of the particles. But in these red gold solutions the size of the particles is only $\frac{1}{100}$ of this, and the formula then shows us that the rate of settling for these particles is only $\frac{1}{10,000}$ of that of the larger particles. A depth of one inch of these red solutions therefore would clear by settling, not in ten minutes, but in about 2½ months!

The colloidal solutions of gold, and solutions of silver prepared in a similar manner, are of great interest because of the beautiful colours they display, and the cause of the colour variations is exactly the same as that of the blue colour of the sky. The latter has been known for some time to be due to the effect of extremely minute dust particles or globules of water in the atmosphere, and the colours of the gold and silver solutions are similarly dependent upon the small particles of the metals in the solutions. Colloidal gold solutions vary from bright ruby red to violet or blue, and colloidal silver solutions show variations from blue to light brown, and in some cases have a greenish tinge.

How Deltas are Formed

Quicker methods are available for causing the particles of a colloidal suspension to settle, and of these the most important is the addition of solutions of such substances as salt and alum. It is this effect that enables us to explain exactly why the Nile, the Ganges and many other rivers form deltas. The usual explanation of deltas is that they are formed as the result of the slowing down of the current of a river and the consequent settling down of the soil carried with it; but there is also another cause for this settling. A delta-forming river, such as the Nile, has large quantities of finely divided soil washed into it during its long and tortuous journey to the sea, and in its lower reaches it is always muddy, being really a colloidal suspension of soil in water. As we saw above, if the soil is very finely divided it will take an almost incredibly long time to settle, even if the river is still, but as the river approaches the sea the percentage of salt is largely increased, and consequently the suspended solids settle down very rapidly. The result is the formation of bars and a delta by the precipitation of the soil brought down by the river.

The colloids already referred to as emulsoids have the peculiar property of preventing the settling of the suspension colloids, and many important processes depend on this.

Colloid Chemistry Important in Photography

Perhaps the best example of this protective action of emulsoids in keeping solids in suspension is the use of gelatine in the preparation of photographic plates. The active agent of a photographic plate is silver bromide, and this is prepared by mixing together solutions of silver nitrate and potassium bromide, both easily soluble substances. If this is done in the ordinary way, the silver bromide will separate out as a thick yellow curd, so coarse that it is useless for photography. The actual method employed, therefore, is to dissolve gelatine in the solutions (*Continued on page 406*)

THE OUTDOOR WORLD—No. 3

The Life Story of a Trout

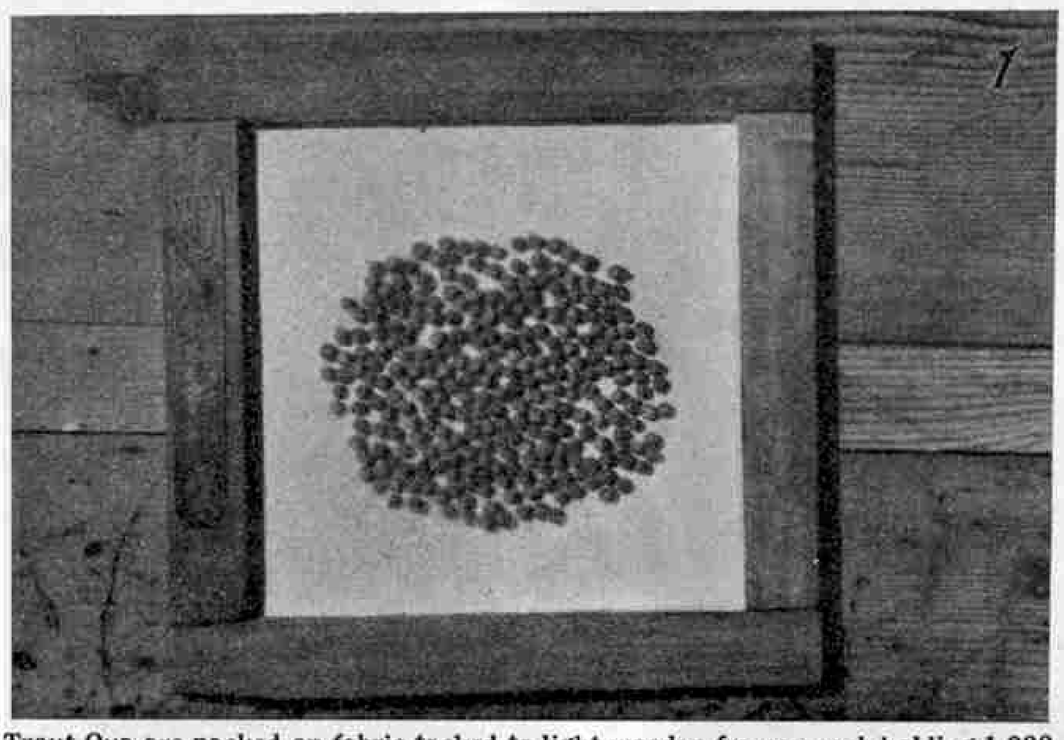
THE life history of a trout is a most interesting subject to the angler as well as to the naturalist, although there are many fishermen of long standing and experience who only possess the most hazy notions of the reproduction and growth of this very sporting fish.

Literature upon the subject, whilst not exactly scarce, trends towards the solid variety with long Latin names adorning nearly every paragraph! Scarcely the kind of reading that a fly fisher may be expected to enjoy over a pipe after dinner: the result is not infrequently—slumber.

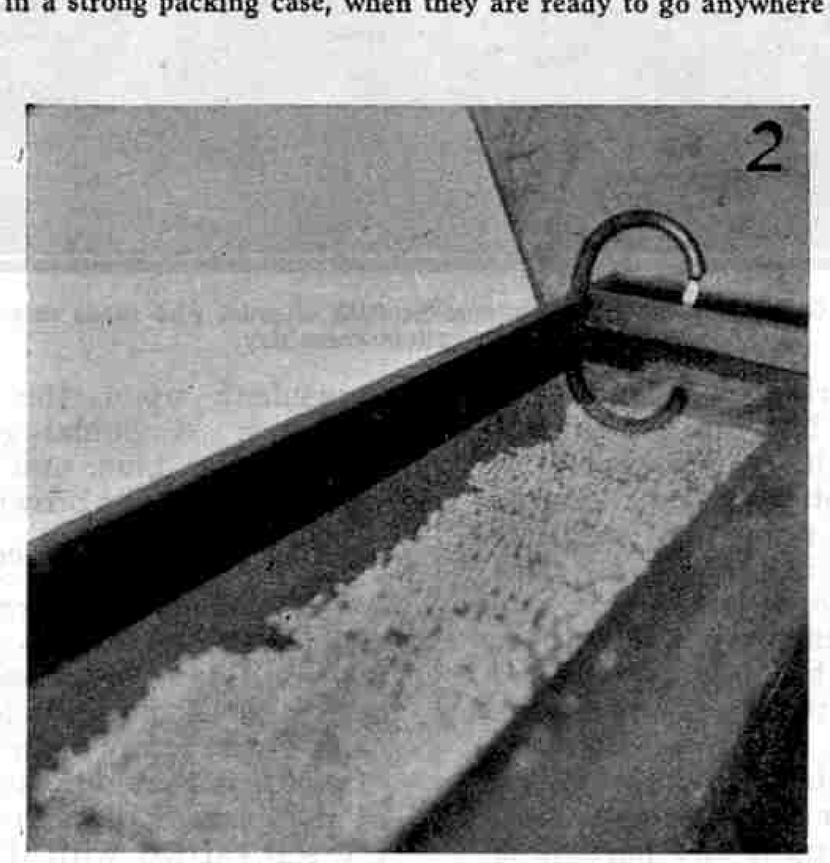
In natural circumstances trout pair off and, towards the late Autumn, make their way up stream to the very small brooks of the watershed, selecting some pool with a clean fine gravelly bottom. Here the spawner, or female, deposits her eggs in a trench she makes in the gravel, rooting it up with her tail as she swims along, and the milter or male fish follows along shedding the milt upon the row of eggs. Both then depart down stream to deeper water where they are more safe and the rest of the affair is left to Nature.

But it is not with the natural aspect of this matter that we have to deal—if it had been, the life history of a trout would be almost fragmentary instead of being a well understood development, because in the natural state opportunity for observation of the progress of the eggs is usually lacking. They may be obscured for days by muddy water, even swept away by flood as they frequently are, or eaten by a host of insects or fishy enemies. Poor trout, their labour is more often in vain than otherwise, and a competent authority estimates than only one in a thousand eggs ever grows into a mature fish.

Nature is invariably prodigal, evidently to make amends for the destruction she permits to take place, and therefore any step which guards against this destruction results ultimately in abundance. That this applies to trout is proven beyond doubt by the various fish culture establishments that annually bring into being literally millions of trout.



Trout Ova are packed on fabric tacked to light wooden frames, each holding 1,000 eggs. The frames are placed one above the other surrounded by wet moss, and enclosed in a strong packing case, when they are ready to go anywhere by train



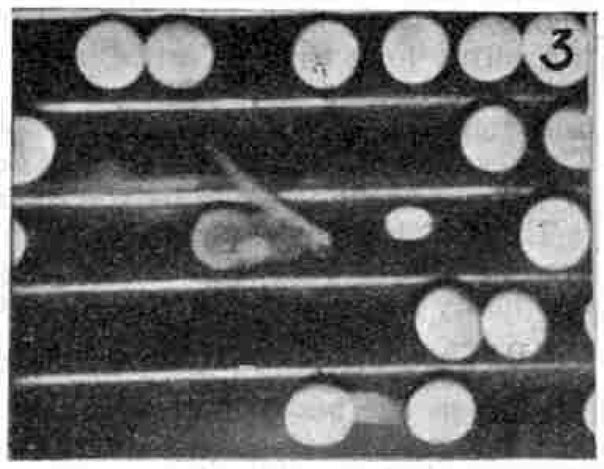
The Hatchery Box showing 2,000 Trout Ova resting upon the grills. This box, if used to its full capacity, would contain 3,500

Tracing the artificial method, as we have the natural one, the process is as follows:—Fine large trout, specially selected for their good form and colouring are kept in "stew ponds," until the spawning time. They are then netted out and placed handy in small tanks. The female is taken in the hands and deftly stripped of her eggs into a shallow earthenware pan similar to those used to develop photographs. The male is stripped on to the ova thus obtained.

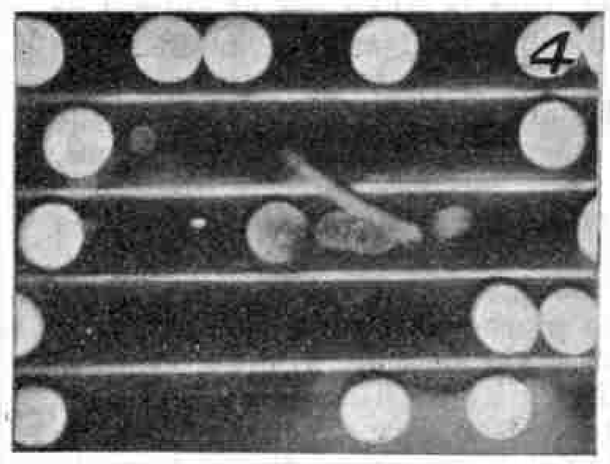
The eggs change colour immediately upon coming in contact with the milt from a colourless mass to a bright pink, and each egg separates and becomes detached. They are then washed in flowing water to remove all traces of the milt which would do great harm if left in contact too long.

In this state the eggs may be carried about in any suitable receptacle containing water, or they may be measured out in a little measure made to contain one thousand (this is the manner of counting them), but they must never be touched by the hand.

A modern hatchery consists of a building so placed that a natural stream of water flows into it. This water is taken through filters and allowed to run gently along a series of troughs, called "hatching boxes." In each box there are



(3) Trout Ova resting on the grills. Photographed life size with a small alevin actually emerging from the egg shell (third grill up, in the centre)



(4) The alevin lies helpless on its side immediately after hatching. The sac, clearly seen attached to the under body of the fish, is full of nourishment to be used by the small trout until it grows big enough to eat. The absorption of the sac occupies from 5 to 6 weeks, according to the temperature of the water

grills made by fixing glass tubes a quarter of an inch in diameter about an eighth of an inch apart. Upon these the ova are carefully placed in rows and they rest between the glass tubes so that there is a free circulation of water all round. Three thousand five hundred eggs can be spread upon one grill and two grills go into each box. Covers are then placed in position to exclude dust and light, the latter being very harmful.

A few days after placing the eggs in the boxes a new stage is reached, and movement of any kind must be avoided. Even an accidental knock on a side of the box will cause the eggs to hatch out cripples.

Some of the eggs go wrong even under the most perfect conditions, but generally not very many are lost. The bad ones turn white and must be picked out each day to prevent them affecting the others. Meanwhile the water flows slowly and steadily night and day and must never cease.

The first indication that the process of nature is taking its proper course is the appearance in each egg of two black spots. These are the eyes of the embryo trout, and they develop far in advance of any other portion of it. The eggs have now reached another stage when they may be moved. There is a ready sale for them in this state, and they are gathered up off the grills, packed in wet moss and sent all over England by train.

Almost all private hatcheries prefer to buy their eggs as eyed ova, because they are safe and less liable to loss.

Slightly more elaborate packing arrangements and the free use of ice permit them to be sent over to America and even through the tropics down to Australia and New Zealand. It is an interesting fact that the rivers in the latter country did not contain trout until eggs were sent over from England to populate the streams.

The ova are next re-spread on the grills in the hatching boxes and from now onwards to hatching the process is one of simple care and attention.

The length of time between spawning and hatching is from 100 to 120 days, the time varying with the temperature of the water. The process of development is delayed by cold and may be accelerated by raising the temperature of the water a few degrees.

The actual hatching is another critical period, because it is not uncommon to have many fish suffocated in the process of emerging from the eggs. The little creatures that accomplish this feat safely slip down between the glass tubes and when all are hatched the grill may be lifted out bringing with it all the empty egg shells.

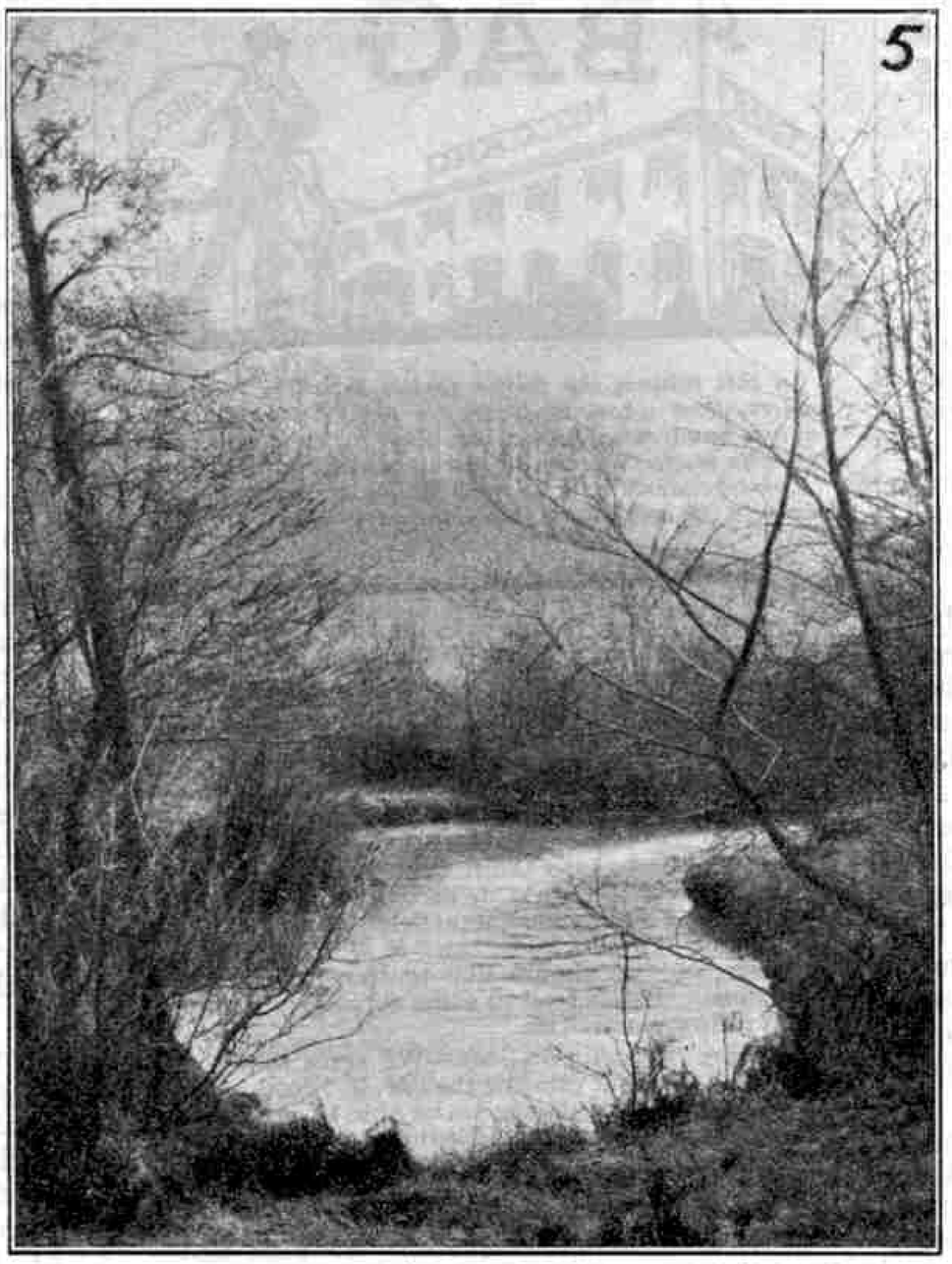
The resultant shoal of minute beings is now found clustered together at the bottom of the box, all heads pointing against the current and each little fish panting as if out of breath. They look the personification of helplessness. At this stage of their life they are called "alevins."

Each tiny fish is provided with a sac attached to the stomach behind the throat. Nourishment is drawn from this sac until such time as the fish has grown strong enough to take food through the mouth, which does not take place until some five or six weeks after hatching.

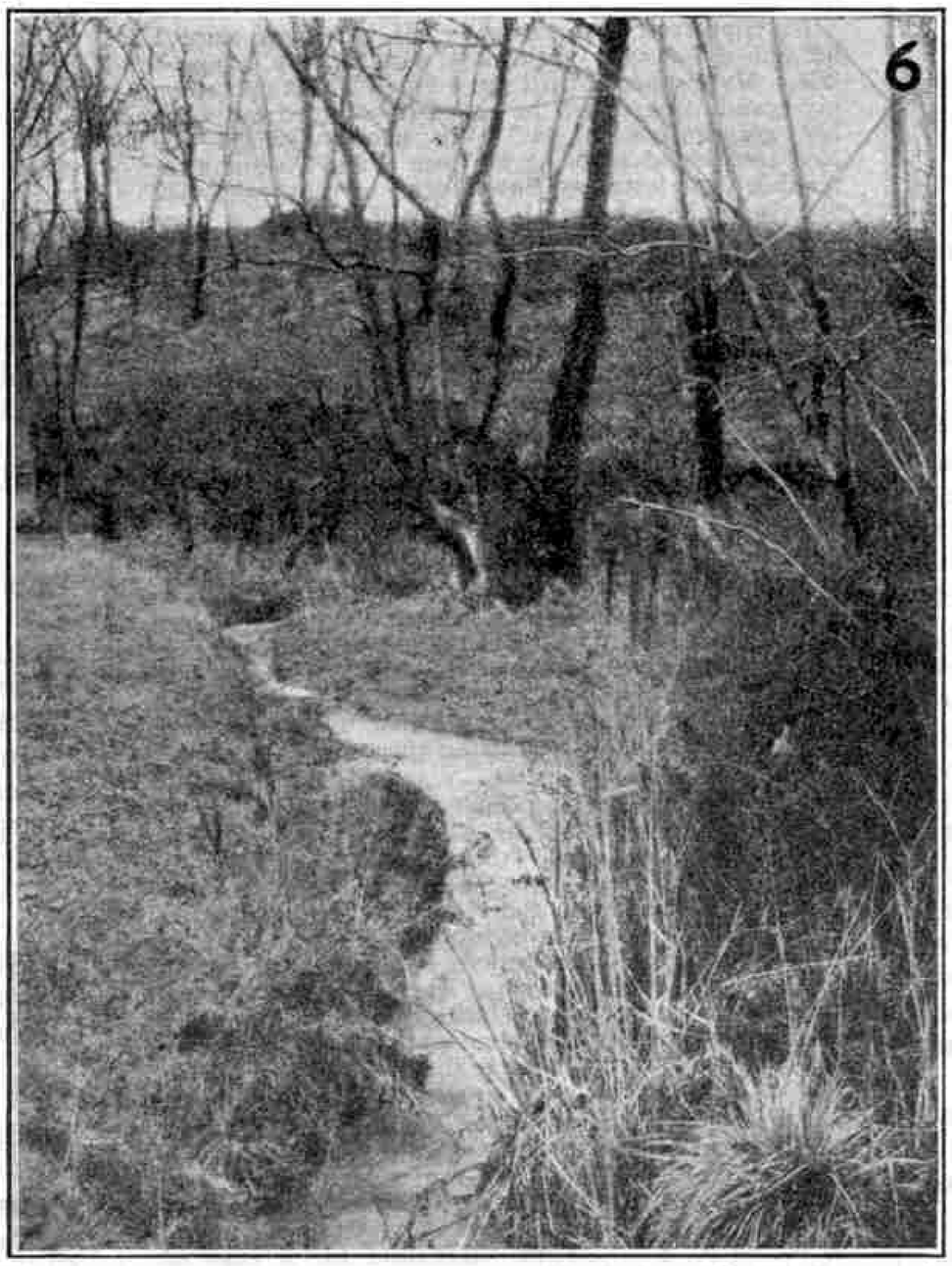
Considerable trouble is often experienced in getting the small fish to start eating and the food must be sub-divided into the smallest possible particles. One of the first things that is tried is the yolk of a hard boiled egg mixed with water to the consistency of cream, so that, when poured into the hatching box, it may diffuse and present separate morsels of food for the small fish to consume. This diet must be used with care for if given too often it will upset the alevins because really it is too rich. Liver, either shredded raw or over-boiled till dry and grated fine, makes a variation that is safer and more suitable for constant use.

With luck the fish will grow rapidly and soon attain the length of an inch, when they are known as "trout fry." Of course there are deaths and any cripples that have been hatched now become more noticeable on account of increasing size. Sometimes these are horrid little things with two heads and one tail, or with curved spines and other deformities. Attempts that have been made to rear them as curiosities have failed. The cripples never live long and are best killed at once when noticed.

The next step is indeed an epoch of the greatest importance. Up to now the young fish have



A quiet pool for the Yearlings



A small brook in which trout spawn when in natural conditions

lived in a wood box containing flowing water. This was all very well until they grew to rather over one inch in length but they must now be removed to more spacious quarters. They are therefore placed in a specially prepared pond with water flowing in at one end and out of the other, each orifice being guarded with perforated zinc to prevent them escaping. Here they remain, being fed two or three times a day, until by the following September they will be four inches in length and are then called "yearlings."

In the pond they have a much better time because in addition to the food given to them there are quantities of natural food. It is this yearling period that is so useful in teaching them to take their food from the surface of the water so that they may be free risers to the fly on reaching maturity.

As trout are carnivorous they must be fed upon flesh and if they are underfed they will develop cannibalism upon the least provocation. Although small pieces of meat or chopped worms would be excellent food, the grave disadvantage is that this food sinks. Therefore, worms are given very rarely and meat is usually boiled long enough to render it dry, after which it is ground up. In this form it will float for a short time and quite long enough for the fish to gobble it up from the surface. This is the secret of obtaining good sport with the fly . . . surface feeding.

Yearling trout are sent in special fish carriers by train anywhere in England with the greatest of ease and are turned out into the rivers any time during the winter months. The best month for turning them out is September although railway travelling may then be dangerous because of the warmth of the weather. When placed in the main stream at this time some decent weather remains for them to become settled before the winter floods occur scattering them throughout the length of the stream. The very best fish always make upwards, but those swept down soon learn to look after themselves and often make good fish also. After all, the cost of stocking a de-populated river is not a very serious item and a stream can be made into really good fishing providing the water is suitable.

In thus artificially making a fishing, the point may be raised that such tame fish will not be sufficiently wary to afford really good sport, and to some extent this is the case. The following season these fish go like a bull at a gate for anything that looks like a fly, and in this they are not far different from young wild fish. They soon learn, however, and only let them survive one or two season's fishing and by then Nature, instinct, or whatever it may be called, has asserted itself, and the fish—shovelled about when in the egg, and hand fed as fry and yearlings—becomes as shy and as fastidious as any wild fish. He will probably fight better when hooked.

It is a joy to take a trout with the artificial fly and the pleasure is doubled when, after a good sporting fight, one finds the fish splendidly proportioned and tinted with the inimitable pearl shades as the brown of the back merges into the golden side and the white belly.

This interesting article, written by a trout fisherman, is reprinted by permission of the Editor of the "Bombshell," the house organ of Thos. Firth & Sons Ltd., Sheffield, who also kindly loaned the blocks to illustrate it.

OUR MAIL BAG

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

E. Whitworth (Manchester).—Your suggestion for articles on Chemistry is quite good and you will be interested to hear that articles of this nature are to be commenced very soon. These will describe fascinating experiments that can be carried out by any reader without any special apparatus. Look out for these articles and let us know what you think of them.

Mr. V. A. Ditcham (London, N.13).—We are delighted to hear of the pleasure the Hornby Railway gives your boys. "Business is business," of course, but when the product is something that brings increased happiness into the lives of tens of thousands of boys all over the world, it becomes something more than merely a commercial article. You will have noticed our new articles in the "*M.M.*" on Miniature Railways and we should like to have your opinion upon them. Please send us some account of your own boys' railway activities.

J. Mears (Westcliff-on-Sea).—We agree that it is a very great pity that printing the "*M.M.*" costs money! We should very much like to be able to produce the present Magazine at its old price, but this is quite impossible. Still, as you know, good things are never cheap, and we think the "*M.M.*" is splendid value for the money. Don't you?

E. Harwood (Rondebosch, S.A.)—We quite understand that your examination work has prevented you from writing to us so often. We are interested to hear that your Dad is an enthusiastic reader of the "*M.M.*" and that if he gets hold of it before you on the day of its arrival your chances of getting a glimpse of it for a week or so are very small! A certain Australian reader recently complained bitterly to us that his Dad always sent him to bed early when the "*M.M.*" arrived and sat up until the small hours reading it himself!

K. Hipperson (Taverham).—"It is a year since I became a Meccano enthusiast and thereby hangs a tale. My mother bought me a No. 5 Outfit and when my grandfather saw it he promptly ordered me a 5A. My grandfather is 84." We usually regard the Meccano period as being between 5 and 70 but after reading your letter we have begun to think seriously of raising the age limit! Perhaps if you win a prize in one of our Model-building Competitions your grandfather may be induced to buy you a 6A and then you will be quite at the top of the tree!

J. Viljoen (Spitskrans, Bethlehem, S.A.)—"In the examination there were two questions and compositions. One was to describe a journey from Cape Town to Johannesburg by aeroplane. The other was to explain the difference between an airship and an aeroplane. For each of these I got 80 marks and also a book prize. It was nothing else than the "*M.M.*" that taught me such good English." We are very interested to hear that the Magazine has been so useful to you, J.V., and we congratulate you upon your successes.

F. Johnson (Mansfield).—Your suggestion for astronomical articles has been made by many readers and we intend to publish such articles from time to time. If there is sufficient demand we may make astronomy a regular feature. Let us know what you think about our articles on the eclipse.

S. Lucas (London, N.8).—We are glad you like our railway articles, especially those by Mr. C. J. Allen. Your suggestion for notes from various parts of the country is already being carried out to some extent. Already we have notes from Leeds, York, Bradford and district, and from Glasgow, and notes from other districts will be added from time to time. We receive many contributions of this nature, but so many of them contain more or less serious inaccuracies that we are very chary of using them until we gain confidence in our correspondents. We hope you will send us notes from time to time on railway happenings in your locality.

S. P. Storey (Bristol).—We are glad to note that you have persuaded several of your adult friends to become "*M.M.*" readers and that their opinions are, "in common with the many thousand opinions of those who might be called the 'Ever-Readers' of the '*M.M.*'—'A 1.'" Your suggestion for a page of "Motor News of the Month" is quite good and will be carefully considered.

Falling an Inch in 2½ Months—

(*Continued from page* 403)

before mixing, with the result that the silver bromide is obtained as a colloidal suspension of very fine particles in a condition of great sensitivity to light, while the grain of the entire emulsion is very fine.

The same property of emulsoids helps to explain the reason for the muddiness of some rivers in comparison with others. The Mississippi, for instance, is always muddy, while its tributary, the Ohio, is a clear stream except when in flood. In the water of the latter river lime and various salts are dissolved and these prevent the formation of colloidal suspensions, whereas in the Mississippi there is a large amount of organic matter derived from decayed vegetation, and this, as we have seen, helps to keep the soil in suspension.

Besides exercising this protective action, emulsoids may be the actual cause of the formation of suspension colloids. One case of very great historic interest is furnished by the use of clay in brick-making. Clay is made plastic by mixing with water, and it owes its plasticity to the fact that it forms a colloidal suspension in these circumstances. It was discovered by Dr. E. G. Acheson, an American scientist, that the formation of this colloidal suspension is assisted, and the clay is rendered more readily plastic, by treatment with dilute solution of tannin, a plant product used for tanning or turning skins into leather. In addition, the strength of the dry brick produced is greatly increased. Tannin has already been mentioned as an organic substance that forms an emulsoid, so that its action on clay is what we should expect.

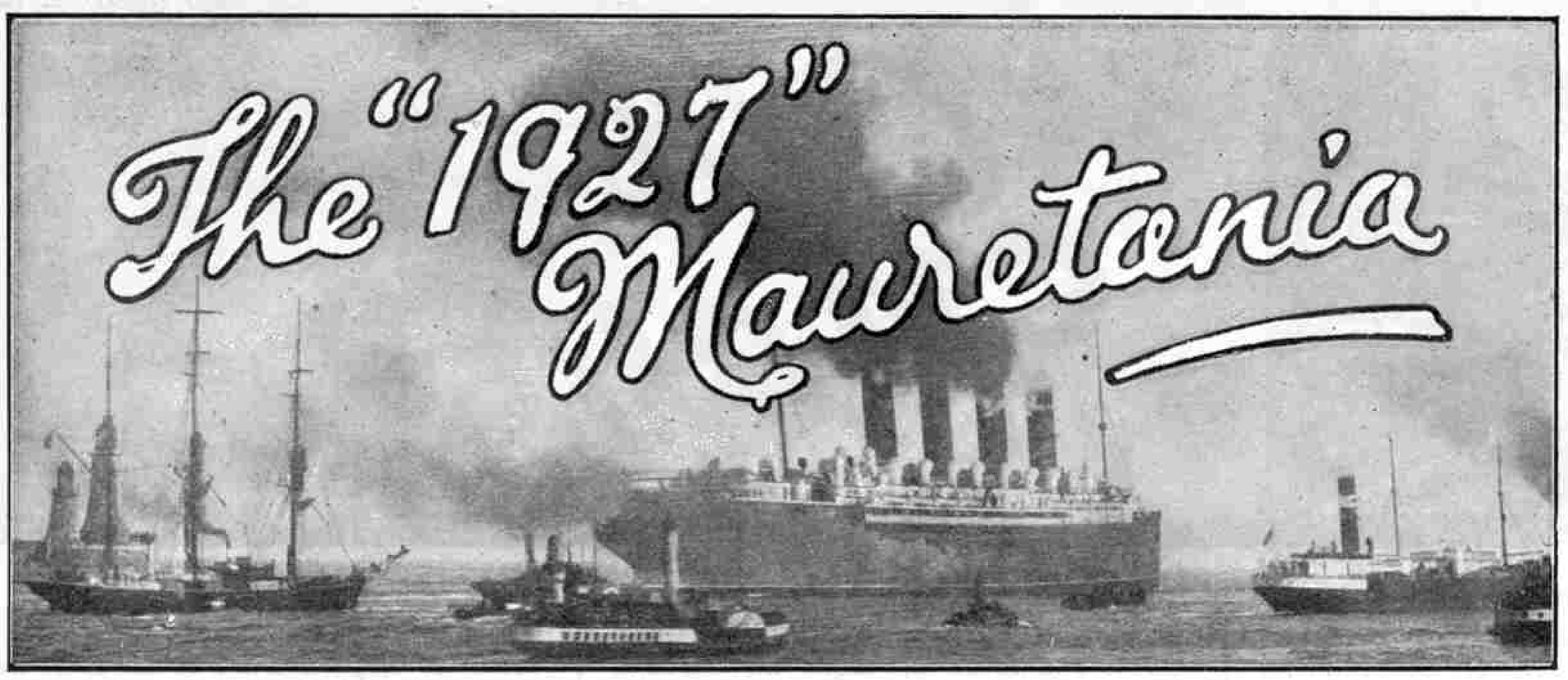
Bricks Without Straw—A New Explanation

To the clay thus rendered more plastic by tannin Dr. Acheson gave the name of Egyptianised clay, because of an attractive theory that was proposed to explain the complaint of the Israelites in Egypt that they were expected to make bricks without straw. This complaint has always been a puzzle, as straw does not appear to be a very suitable material for brick-making, and the only explanation that seemed at all likely was that the straw was used as a binding material, just as hair is used in mortar. This was not very satisfactory, however, especially in view of the fact that stubble also was used for the same purpose, as neither straw nor stubble appear to have the necessary toughness.

It has now been found that straw contains a substance that acts on clay exactly as tannin does, making it more plastic. A more attractive explanation than the old one, then, is that in the absence of straw the Israelites were compelled to use clay that would be difficult to mould and would produce bricks that were easily broken. Thus, after six thousand years, we are able to explain the historic puzzle by the aid of a few comparatively simple experiments.

The straw was useful also for keeping the clay open so that it dried evenly, a purpose for which sawdust is now often used. The usual method of making clay plastic is to leave it in contact with cheap organic material such as peat or tannery waste, and it is said that the highly-skilled Chinese potters often kept clay for their finest work for a hundred years.

The "1927" Mauretania



AFTER EXTENSIVE ALTER-ATIONS, THE FAMOUS LINER IS ONCE AGAIN IN COMMISSION

(Reprinted by permission of the Editor, "*Cunard Magazine*")

The world's fastest liner is now on a cruise in the Mediterranean after a thorough overhaul. The "Mauretania" was recently subjected to a speed trial in the English Channel. For two hours a speed of 26 knots was easily maintained—a result that seems to show this fine vessel to be possessed of as good a speed as ever. She holds the speed record for the Atlantic crossing, having crossed from Cherbourg to New York in 5 days 3 hrs. 20 mins.

IT is not too much to assume that if it were possible to ascertain by world plebiscite the name of the best known and the most famous ship, the name would be found to be "*Mauretania.*" The Cunarder has always been extremely popular. She has carried more passengers than any other ship in commission and steamed a greater distance than any other passenger liner.

For several years now the "*Mauretania*" has regularly made her three channel ports in one day—Plymouth, Cherbourg and Southampton. The passenger leaving New York by her on the Wednesday morning, can be in London five and a half days later. No other ship can accomplish this. To-day she is still the world's fastest liner. At the time she was commissioned, she was without doubt the supreme example of British workmanship afloat. She is still unique amongst the world's liners.

The "*Mauretania*" has recently been at her old port, Liverpool, undergoing extensive alterations and overhaul. This work has been superintended by the three departments—engineering, deck and furnishing, and altogether an army of 2,000 men and women have been engaged on various work. These people included joiners, decorators, gilders, cabinet makers, marble masons, mosaic layers, polishers, parquet floor experts, upholsterers, carvers, chair makers, wood turners, fitters, boiler-makers, electricians and sempstresses.

The work carried out by the engineering department included fitting two new propellers, each weighing 18 tons, and also a new shaft of a similar weight. The ship's 192 furnaces were cleaned and the six turbines, weighing hundreds of tons with their hundreds of thousands of blades, were overhauled. A new oil fuel storage bunker has been built, which increases the oil fuel capacity to over 7,000 tons. The miles of steam pipes were tested, and a new calorifier fitted to supplement the existing hot water system. The four turbo-generators, each of 375 kilowatts, were tested, and the various electric attachments were carefully overhauled.

Extensive alterations have been made in the passenger accommodation. No fewer than 100 state-rooms have been replanned. Hot and cold running water has been introduced into every first-class stateroom, with fans and electric radiators. In each of these staterooms there is now a bed, and where a Pullman berth exists, a new scheme has been introduced, whereby the Pullman is transformed to give the effect of an eighteenth century four-post bed with valances and curtains in modern colourings. Big cupboards, baggage guards for innovation trunks and smaller conveniences of various kinds have been introduced into every room.

The staterooms on "A" deck have been entirely renovated. In the *en suite* rooms the wonderful onyx marble originally fitted has been renovated and brought back to its original lustre. The principal outside staterooms on "B" deck have been increased in size. This has enabled the provision of wider beds.

Many of the old sections of eight rooms now occupy four rooms only. The Regal suites have also received attention and decorated to suit all tastes. One of these has been treated in a colour scheme based on purple and silver. There is a purple carpet with delicate silver design; the wall fabrics are modern shot silk of a variegated colour of purple and silver, while the curtains are also of a similar purple hue, with silver braiding and fringe. There has been a re-arrangement of most of the staterooms on "C" deck, while those on "D" deck have been entirely rebuilt, giving more space.

Much work has also been done in the various public rooms—drawing room and library, lounge, dining saloons, and smoking room. The verandah café has been remodelled on the lines of the Orangery at Hampton Court. It is also centrally heated and the floor has been specially treated for dancing.

Such are a few of the details of the work accomplished in this famous ship. We think our readers will agree that in the "*Mauretania*" Britain has a great example of the skill of her designers, her engineers and craftsmen, and the Atlantic traveller a ship that will satisfy the passenger's highest hopes of luxurious and complete travel comfort. She may not be the world's largest liner, but she still retains her position as the wonder ship of the ocean in the minds of most people.

Air News

Basel Airport Reorganised

The airport at Basel has been reorganised to meet the demands of the Imperial Airways London-Paris-Basel-Zurich route. As the old aerodrome was too small for the 14-seater Handley Pages used on this route, four acres have been added to the grounds, providing sufficient space for expansion. Basel is to be the air terminus where London and Paris passengers will be able to take the night mail to Italy. To meet the passenger demands, Customs Houses, Post Office, etc., have been built at the airpost. The flight from London to Basel will take about six hours, including a stop of 30 minutes at Paris.

* * * *

Czecho-German Air Convention

An important Air Convention recently signed by representatives of Germany and Czecho-Slovakia grants mutual freedom of flight over the frontiers of each country. Previously this was not allowed unless special permission was obtained.

Provision has been made also for the addition of four regular services operating between the two countries. The chief of these will be the service between Berlin and Vienna via Dresden and Prague, operated by the German and Austrian air service contractors. Two other services, one joining this route with Copenhagen and Malmo, the other linking Gleiwitz, Brunn, Vienna, Prague and Chemnitz, will be inaugurated soon afterwards. The fourth route will be to Breslau, Prague and Munich, with an extension to Geneva.

* * * *

Lieut. Bernard, of the French Naval Air Service has completed a flight between France and Madagascar, landing in Paris three months after his departure from Berre. The distance covered was 18,000 miles. Lt. Bernard's machine was a Liore and Oliver flying-boat fitted with a Jupiter air-cooled engine.

* * * *

Avian Light Aeroplanes for Owner-Pilots

The Avian two-seater light aeroplane is now being manufactured by A. V. Roe & Co. Ltd., at their Manchester works. The price of the machine is £675 if fitted with Cirrus Mk. II. engine and £750 with Armstrong-Siddeley Genet engine. Each machine is fully equipped with everything necessary for flight. An interesting innovation is the provision at the Hamble or Woodford aerodromes of free landing ground and housing accommodation for any privately-owned Avian machine.

Night Service on Trans-Continental Routes

The Luft Hansa have decided to inaugurate a number of night air services on trans-Continental routes. One of these services is between London and Germany. A German air liner will leave Croydon Aerodrome daily at 4 a.m. for Amsterdam, Hanover and Berlin, with connections to Scandinavia and Russia. A liner operating in the return direction will arrive at Croydon from Germany at 8-30 a.m. daily.

The most luxurious air liner ever built has been constructed in Germany for use on this route. The machine is a triple-screw all-metal Junkers monoplane and will be driven by three British Napier engines, totalling 1,500 h.p. It is anticipated that a speed of 125 m.p.h. will be attained. Two decks are provided, the upper one for passengers and the lower one for cargo. The passenger deck is divided into three compartments, each containing a number of full-sized sleeping berths, each fitted with individual electric light and attendant's bell. Ten passengers can be accommodated in these berths.

* * * *

Cycling in the Air

Trials are now being made in various countries of flying machines in which the pilot provides the propelling power through mechanism driven by his arms or legs. Among these experimenters is Mr. J. E. Palmer of Andover, who states that while suspended from a small balloon he has succeeded in propelling himself for about a mile by means of two paddle-shaped attachments on his arms. He has also another device under construction consisting of a cigar-shaped gas container filled with hydrogen and supporting an aluminium framework resembling a bicycle. The idea is for the balloon to lift the pilot into the air and for a horizontal motion to be obtained by means of a pedal-driven propeller.

* * * *

International Register of Aircraft

During the past five years a complete register of French aircraft has been kept by the Bureau Veritas, who have also drawn up and enforced an elaborate system of rules for the construction and survey of all types of machines. An arrangement has now been made between the Bureau Veritas, the British Corporation for the Survey and Register of Shipping and the classification societies in America, Japan, Germany and Norway with a view to creating an International Register of Aircraft. This step has the approval of the Air Ministry's Department of Civil Aviation.

Submarine Aircraft Carriers

In our notes for March we referred to recent developments in submarine aircraft carriers. In the United States a seaplane has been specially designed and constructed for this work. It is a small single-seater biplane fitted with twin floats and having a wing stretch of 18 ft. The fuselage is built of welded steel tubing and the wings and tail of duralumin. A 60 h.p. Wright three-cylinder engine is fitted, giving a maximum speed of about 100 m.p.h. The maximum range is about 200 miles.

French experts also have produced similar machines and a small two-seater seaplane, fitted with a Salmson 120 h.p. engine has been manufactured by the Besson Company.

It is interesting to note that the German Caspar "U.1." was the first seaplane of this type to be designed.

* * * *

Airships for Spanish–South American Service

A new airship, "L.Z.127," is under construction in Germany for a new Spanish–South American service that is to be commenced about the end of this year. It is to have 20-berth cabins, a lounge, and a dining room for 40 passengers. As a trial flight it is proposed to take the airship to the North Pole. The service in which this airship will probably operate is on a route between Seville and Buenos Aires.

* * * *

Shopping Excursions to Paris

Imperial Airways intend to introduce one-day shopping excursions between Paris and London. The liners will leave Croydon at 7-15 a.m. and return from Le Bourget at 6-30 p.m., allowing about seven hours in Paris. No definite arrangements have been made so far in regard to a return service, but it is suggested that French shoppers might come to London under similar conditions.

* * * *

Bolivian Air Services

Extensive air services are to be developed shortly by the Government of Bolivia, South America. These will probably include weekly services for both passengers and goods between La Paz, Trinidad, Riberalta and Cobija, and La Paz and Suerf. A service between Cochabamba and Santa Cruz has been operated by five monoplanes for over a year. This route is over territory entirely unserved by railways, and the air service has been so successful that the Government are extending the system.

Plans for New American Airship

The plans for the construction of a dirigible to replace the "*Shenandoah*" show that the new ship will have a gas capacity of 6,500,000 cu. ft. The control cabin and passenger accommodation will be enclosed within the hull. The engines also will be within the hull in contrast to previous airship designs in which the engines have been carried in small gondolas suspended from the hull. Arrangements have been made whereby the propellers may be tilted through an angle of 90 degrees so that their thrust can be added to the lift of the ship when taking off. Two complete covers for the gas container are to be provided, one on the outside of the wing frames and the other on the inside, the gas cells being within the latter.

Two sets of plans have been prepared, one for a military ship and the other for a passenger ship, and one ship is to be built to each plan. The passenger-carrying craft will have accommodation for 100 passengers. The maximum range of these airships will be 8,000 miles, or 6,000 miles at the maximum speed of 90 m.p.h.

* * * *

Oslo-England Seaplane Service

Trial flights between Oslo and Harwich or Felixstowe have been arranged by the Norwegian Aero Club. Two alternative routes will be tried, the first via Christiansand, Jutland, Cuxhaven and Amsterdam, and the second to Kiel and Amsterdam via the Swedish coast.

* * * *

Another Atlantic Trial

Capt. Fonck, the famous French pilot, is to attempt another flight across the Atlantic. His last effort was made in September 1926, and was unsuccessful. It is probable that he will use a Sikorsky machine as he did last year.

* * * *

Spain—New York Flight

Major Franco who succeeded in flying across the South Atlantic last year intends to make a non-stop flight from Spain to New York by seaplane, using a considerably larger and more powerful machine than he used for his last big flight. If the machine is ready the flight probably will take place in July.

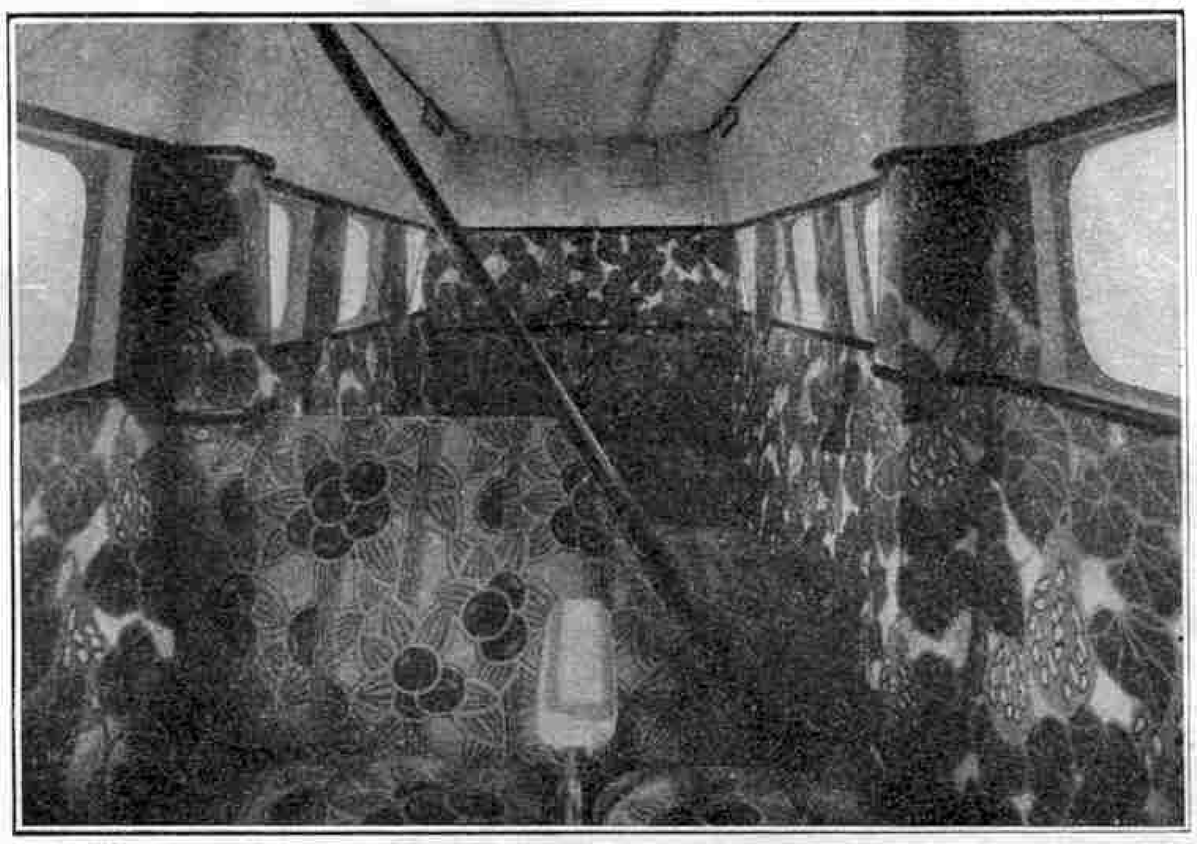
* * * *

Fuel-Saving Propeller

A new aeroplane design contains an interesting new type of propeller. Instead of the usual two-blade pattern this propeller contains no less than twenty-four blades, but the diameter is very much smaller than that of the usual type of air screw. It is claimed that the new propeller results in a great saving in petrol.

The aeroplane to which it is to be fitted has been designed for use on a non-stop flight from New York to Paris. Among other features the machine has wings 90 ft. in length and four air-cooled engines each of 225 h.p.

A Pullman of the Air



Our photograph shows the luxurious appointments in the passenger cabin of one of the Farman F. 171 aeroplanes

Openings for Officers in the Air Force

The Air Ministry is prepared to consider applications for short service commissions from candidates between 18 and 25. Officers will be trained in this country or in Egypt and may subsequently be employed almost anywhere at home and abroad. This is an opportunity that should appeal to young men of spirit and especially to those who have a bent towards mechanical studies, for officers receive every encouragement to continue their aeronautical studies when their regulation training is finished. The commissions are for five years, after which four years are spent in the Reserve.

A small proportion of short service officers are to be retained on permanent commissions that are granted on the results of competitive examinations held annually in mathematical and scientific subjects open to officers with three years' service. Certain short service officers are also selected for permanent commissions on the recommendation of their commanding officers.

The pay is 15/- a day plus allowances of various kinds, rising eventually to 21/8 per day, while a gratuity of £375 is paid on entering the Reserve. Applications for forms and regulations should be addressed without delay to the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

* * * *

British Attempt on World's Record

An attempt is to be made by a British machine on the world's long-distance record at present held by two French airmen for a flight from Paris to Jask, a distance of 3,345 miles. A Hawker "Horsley" machine fitted with a Rolls-Royce "Condor" engine is to be used for the purpose. The bombing apparatus has been removed from the machine and extra petrol tanks have been installed, the total capacity of which is more than 1,000 gallons. The machine probably will be manned by R.A.F. personnel and not by civilians.

The Ford "Flivver"

The much-discussed Ford aeroplane is now an accomplished fact. It has been designed by Otto Kroppen of the Ford Aeroplane Division, and it is a single-seater monoplane, fitted with a 35 h.p. 3-cylinder air-cooled Anzani engine. The fuselage contains a comfortable cockpit from which the pilot obtains a wide view. The wing is of the cantilever type of fairly thick section, and has a span of 22 ft. The under-carriage consists of two wheels each supported by three steel tube struts, one sloping to the fuselage and the other two extending up to the main plane. An interesting device is the inclusion of a rubber disc shock absorber in the main strut. These rubber discs are moulded into brass rings previous to assembly in order to reduce wear during use. A third wheel is fitted at the tail and is provided with a brake so that the tail-skid effect can be obtained.

Special efforts have been made to reduce engine noise as much as possible. The three exhausts from the cylinders lead into an inverted U-shaped manifold at the two outlets on which standard Ford car exhausts are fitted. Although the engine is not absolutely silent it is claimed that the exhaust noises are reduced by some 50 per cent.

It is stated that Mr. Ford does not intend to manufacture the machine on mass-production lines at present but that he is experimenting in order to investigate the possibilities of producing an aeroplane at a price compatible with that of his car.

* * * *

Proposed Light Aeroplane's Flight

Mr. Bert Hinkler is planning a flight to Australia in an Aero "Avian" light aeroplane fitted with a 60 h.p. Cirrus air-cooled engine. The machine has a maximum speed of 105 m.p.h. with a normal speed of 90 m.p.h., and Mr. Hinkler will attempt to do the journey in 14 days.

A flight to the Antipodes is contemplated also by Capt. Courtney, who proposes to make a trip to New Zealand in ten days, using a flying boat.

* * * *

Commander Byrd to Fly Atlantic

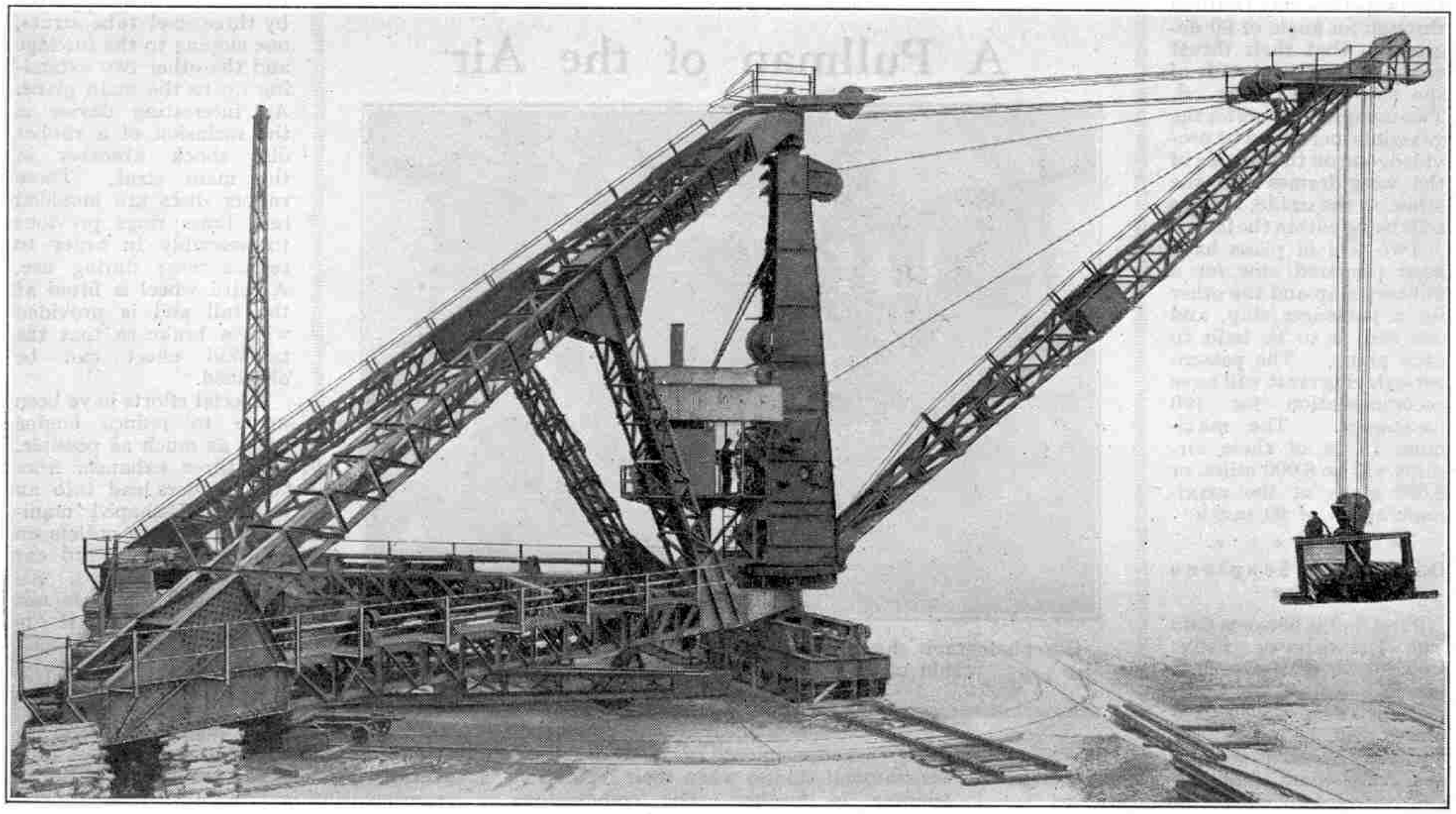
Commander R. Byrd, of the United States Naval Air Service, who succeeded in a flight to the North Pole in April 1926, is to attempt a non-stop flight across the Atlantic in competition for the Raymond Orteig prize. His machine will be a three-engined Fokker monoplane.

* * * *

A proposal for the reserving of 80 ft. of beach at Bournemouth for flights during the summer has been put forward. The proposal has been criticised on the ground of danger to children and bathers, but it is to be given further consideration. If the scheme materialises a service between Bournemouth and the Isle of Wight may be inaugurated.

A 62-ton Steam Derrick Crane

A good subject for a Meccano Model



The Crane lifting a test load of 75 tons

WE have described various types of cranes from time to time in these pages—particularly Giant Block-setting Cranes—but the type dealt with in the present article will probably be new to our readers. Known technically as a steam travelling derrick crane, it is a powerful crane and possesses special features.

It was built by the firm of Joseph Booth and Bros. Ltd., Rodley, near Leeds, for use in connection with harbour works at Valparaiso that were being carried out by a firm of British engineers for the Chilian Government.

Although designed to lift a load of 62 tons, the crane, under test, easily handled 75 tons, and the photograph on this page was taken with that weight in suspension. The view on the next page shows the crane during the process of erection in the builders' yard.

Cranes are always of interest to anyone mechanically inclined. Of course, readers of the "M.M." are particularly interested in them, because they make such excellent subjects for Meccano models, which in turn give many hours of pleasure when constructed. There is no greater fun than hoisting, lowering, and derricking a load with a crane that you have built yourself. It was, in fact, the very thing that led to the invention of the Meccano system.

Adaptable to Varying Gauges

The crane is mounted on four bogies, two being placed under the mast and one at the extreme end of each sleeper. The former are connected by an equalising girder to enable the bogie trucks to travel up an incline of 1 in 72, while the back bogies remain on the level.

The crane is built to travel on two roads, each 5 ft. 6 in. gauge, the mast bogies running on rails fixed on the sea wall, while the travelling bogies run on rails fixed on the staging parallel to the wall and at 50 ft. centres.

In order to allow the crane to adapt itself to variations of gauge, the travelling wheels are arranged to slide on square axles through a distance of 6 in. The crane is further designed so that the sleepers, guys, and back tie girder may be changed to enable the machine to travel on a gauge with 35 ft. centres, the mast bogies in this case being in front and the sleeper bogies trailing or being shunted, as the case may be. The two sleeper bogies are connected by means of a steel lattice girder.

The motions for main hoisting, auxiliary hoisting, derricking, and travelling are all operated by one set of engines, and the hoisting mechanism is fitted with two hydraulic oil cylinder brakes. The slewing is effected by a separate set of engines.

The crane is designed to lift its load at a radius of 60 ft. from the centre of the mast, the hoisting speeds being 10 ft. per minute for the full load and 50 ft. per minute for a load of 10 tons. The speed for auxiliary hoisting is 60 ft. per minute with a load of 10 tons. The revolving

speed is 190 ft. per minute at the hook and the travelling speed 40 ft. per minute.

Details of the Bogies and their Frames

The centre bogies are each mounted on six centre-flanged steel-tired tram wheels, 2 ft. 6 in. in diameter on the tread, tires 2½ in. thick, set to 5 ft. 6 in. centres, and having a wheel base of 24 ft., with axles 6 in. diameter in the journals and 7½ in. diameter in the centre.

The axle-box brackets are of cast iron, machined to take sliding boxes, each supported by two volute springs, a bracket being fixed on each side of the tram wheels. The gearing on the brackets is carried in sliding bearings to allow for movement due to the springs.

The bogie frames are built up of steel plates and angles, all riveted together and arranged to carry the trunnion and travelling gear brackets. Platforms with hand rails are provided on three sides of the centre bogies. The equalising girders are also built up of steel plates and angles, and are connected together by a distance piece of similar construction for carrying the centre trunnion under the mast. Bogie trunnions are provided at each end of the girders.

The two back bogies are built up of steel plates and angles, having horizontal gusset plates for carrying ballast. They are mounted on eight centre-flanged steel-tyred tram wheels, 2 ft. 6 in. diameter, the axles and travelling gear being similar to those of the centre bogies.

The slewing ring foundation is made of steel plates and angles, to which is bolted the spur wheel, which wheel is made in six segments. The steel centre trunnion casting passes through the centre of the ring foundation and supports the ball race, and on the sleeve of the trunnion casting the sleeper ends are carried.

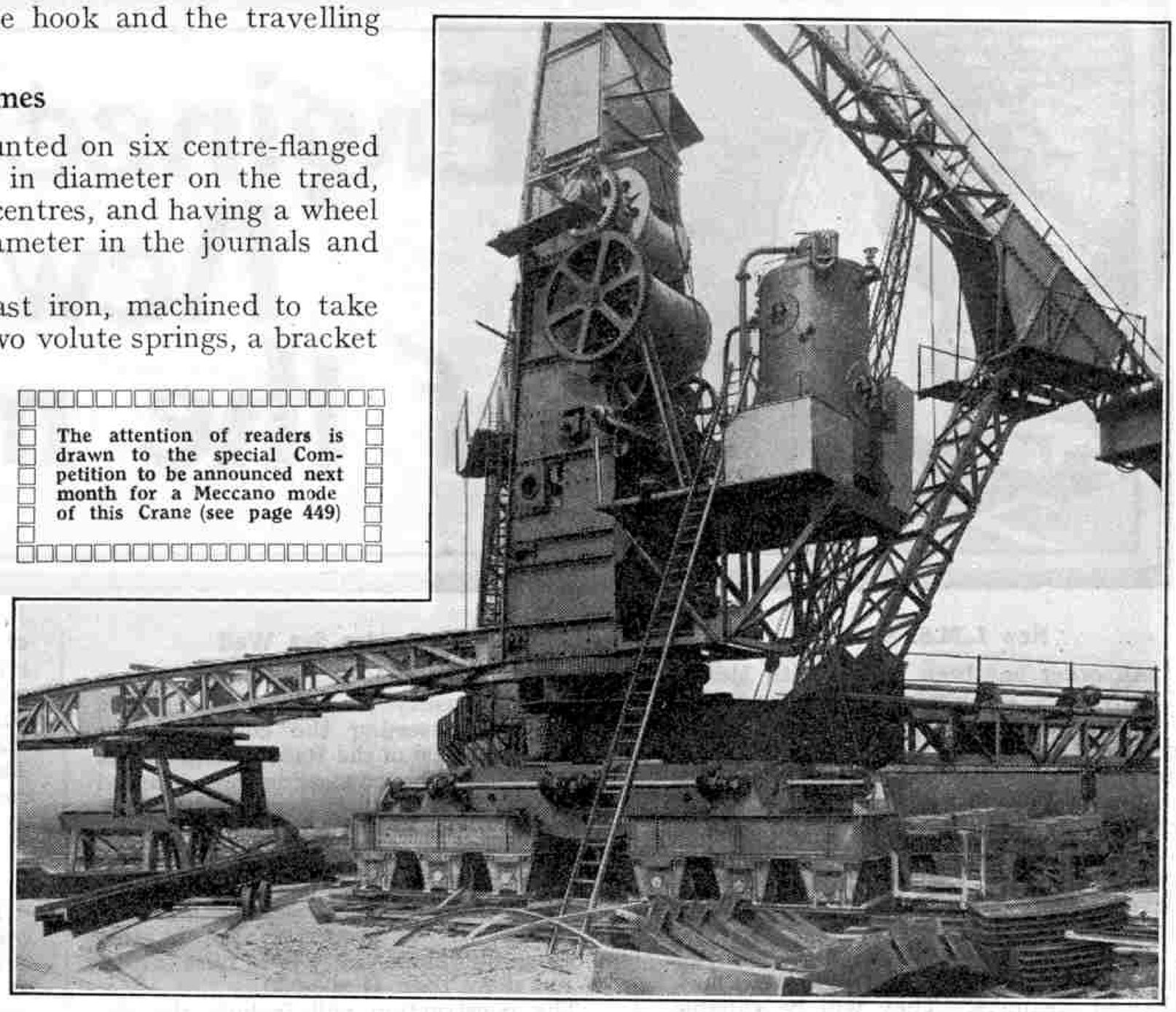
The Mast, Guys and Sleepers

The mast sides, built up of steel plates, ¾ in. thick, and angles, 6 in. by 6 in. by ¾ in., are jointed together by plates and machined bolts. At the bottom of the mast and connecting each side are two large steel plate and angle girders, between which is fitted the centre casting to carry the bottom mast pin. The latter is carried on a double-row ball bearing of special design, the balls being 2 in. diameter and fifty in number.

Between the sides of the mast and in front, the large slewing bracket is fixed, and at the back is the bracket for the slewing engines. Above the slewing engines is a large steel girder for supporting the main engines, while a massive casting for taking the engine shaft and vertical travelling shaft is fixed between the mast sides. On this casting the top ends of the engine slide bars are fixed, and above are two girders to support the cylinders for the oil brakes. The shafts for the hoisting and derricking motions are carried in bearings fitted on the sides of the mast.

The mast top is designed to receive a casting for carrying the top centre pin, which revolves in a phosphor bronze bush, this casting being arranged with trunnions to take the sheer of the bolts. Extension girders are carried out at the front to take the pulleys. The centre pin is secured in place by a circular nut and taper pin on the top.

The attention of readers is drawn to the special Competition to be announced next month for a Meccano mode of this Crane (see page 449)



The Crane during the course of construction

The guys and sleepers are built up of steel plates and angles, lattice pattern, the former being arranged at the mast top so that the angle can be changed to suit the varying centres of the roads. The bottom ends of the guys engage between large plates on the sleepers, to which they are bolted. On one guy a steel ladder is placed to give access to the mast head.

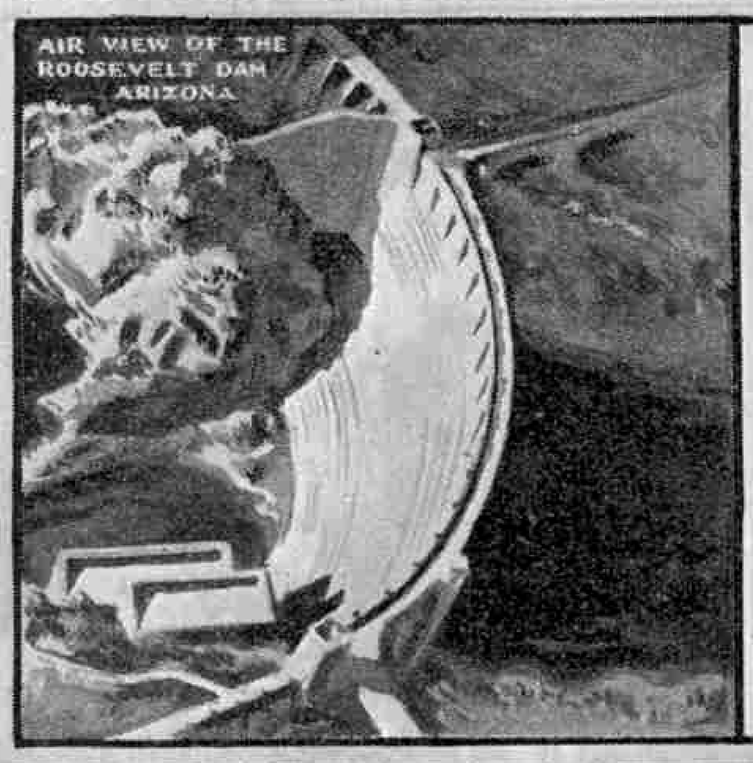
The sleepers are of the lattice type, and at the mast end are arranged in a similar manner to the top of the guys. The back ends are designed to take the guys and also the trunnion for the back bogies.

The travelling gear is driven by shafts carried in brackets on the sleepers. Steel brackets and hand rails are provided on the outside to carry a platform. A distance girder of steel plates and angles is provided between the sleepers, and is jointed so that the centre part will come into position when the crane is travelling on a 35 ft. centre track. Two steel box-section lattice girders are fitted between the sleepers and connected to them by machined bolts.

The jib is of the steel lattice type, measuring 75 ft. between the centres. It is made in two halves, and has large castings at the bottom for taking the steel pin and at the top for taking the jib head pulleys and derrick rods.

Engine Details and Brake Control

The engines for hoisting, derricking, and travelling have a pair of cylinders 10½ in. in diameter by 16 in. stroke, fitted with link motion. The slide bars are of steel, flat on the faces, and fitted with brass strips for adjustment. The slewing engines have a pair of cylinders 8 in. by 10 in. The boiler is of the Spencer-Hopwood type, 5 ft. in diameter by 11 ft. in height, and tested to 200 lb. hydraulic pressure per square inch. (*Cont. on page* 449)



Engineering News of the month.

New L.M.S. Steamers

An order has been placed with Messrs. Denny Bros., of Dumbarton, by the L.M.S. for three new twin-screw turbine steamers, each 360 feet in length. The new steamers are to be placed on the Heysham—Belfast service in accordance with the company's plan to concentrate the north of Ireland steamship traffic on Heysham, while providing improved facilities for the development of the fish and other traffic at Fleetwood.

Each of the three ships will be superior in every respect to the existing cross-channel steamers. They will be capable of steaming at 21 knots and each will carry a motor lifeboat in addition to a standard equipment of lifesaving apparatus.

* * * *

Swiss Water Power Schemes

A scheme for the utilisation of the water power of the Limmat River, near Weltingen, has been prepared by the Zurich municipal authorities and an application for a concession from the Aargau Cantonal authorities has been made. This scheme includes the construction of a dam sufficient to provide an output equivalent to a minimum of 14,000 kw. and a maximum of 25,000 kw. The local authorities of Scanfs, in the Engadine, also have applied for a concession to erect a hydro-electro plant near Taralap. It is considered that a minimum of 300,000 h.p. would be available at the proposed site.

* * * *

New Bridge for Durban

A new bridge to be erected in Durban North will, it is stated, be the longest concrete bridge ever erected by private enterprise. This bridge will be 540 ft. in length, and will consist of five arches and the approaches. A 4 ft. 6 in. footpath will be carried on each side of the spans, which are 48 ft. in width. The maximum height will be 60 ft.

* * * *

Steel Arch Bridge for New York

It is stated that the Port of New York Authority favours a steel arch for the type of bridge to join Bayonne, N.J., and Port Richmond, Staten Island. This bridge is to span the entire width of the Kill van Kull, rising to a height of 150 ft. above high water level. It will be flanked by concrete arched viaducts on each side and will provide six traffic and pedestrian lanes. The estimated cost is about £3,200,000.

Montevideo Sea Wall

A contract has been concluded between the Municipality of Montevideo and a syndicate possessing the concession for the construction of the Rambla Sud (South Sea Wall). The concession was granted originally to a British company in 1909, but the work was abandoned owing to the large number of important alterations insisted upon by the authorities. The plans, as now fixed, involve the purchase of much private property, and for this purpose the municipality is to raise a loan of not more than £1,800,000.

The construction will include the demolition of many buildings, the sinking of submarine foundations and the erection of a wide stretch of retaining wall, and the work will be spread over about six years. The cost of the constructional work is estimated at £600,000 and it is considered that a large proportion of this will be repaid by the sale of frontages on the new thoroughfare.

* * * *

New Motor-Boat Design

A motor-boat intended for an attempt on the speed record of 68 miles per hour set up by "*Miss America VI.*" has been designed by M. Buggati. It is to be driven by two engines, each of 500 h.p. and it is anticipated that a speed of 87 m.p.h. will be attained. M. Buggati proposes to make his boat partly submersible while in motion, somewhat like a submarine travelling awash.

* * * *

Motor Ships to Carry Locomotives

A contract for the construction of two motor ships has been placed with Armstrong, Whitworth & Co. Ltd., by S. A. S. Christen Smith's Rederi, of Oslo. These vessels, each of 4,300 tons, have been designed specially for the transportation of assembled railway locomotives, and will be a development of a similar motor ship, the "*Belray*."

* * * *

Port of Seville Improvement

Extensive alterations will shortly be commenced with the object of improving the Port of Seville. At present the strong current of the river Guadalquivier, when in flood, seriously affects shipping in the harbour and in the Alfonso XIII. Canal, and therefore the river is to be diverted so that it will not flow through the port. A new bed is to be excavated between La Cartuja and the bend of St. Juan, a distance of two miles, and the present course of the river is to be dammed above Triana. This will secure dead water for the whole of the old harbour and the canal, and new quays may be built along the banks of the latter. The work will take nearly four years to complete and will cost about £1,150,000.

* * * *

River Tees Improvements

Plans have been prepared for the widening and deepening of the river Tees from Stockton to the sea, a stretch of about eight miles. The work is to be divided into three sections—from the Fifth Buoy Light to Dock Point, from Dock Point to West Marsh, and from West Marsh to Stockton Corporation Quay, and the reclamation of the Seal Sands, which cover an area of about 267½ acres.

The dredged mud, etc., amounting to about 17,250,000 cu. yds. of material, will be dumped on the Seal Sands, and slag tipped on the top of it. Training walls have been built round the sands. Many years will be required for the completion of the whole work.

* * * *

There is now in operation between Germany and Denmark a ferry boat, the bows of which open for the purpose of loading and discharging cargo, thus forming a sort of huge mouth. The boat has accommodation also for 1,000 passengers.

* * * *

Monster Bridge at San Francisco

One of the largest highway bridges in the world is nearing completion across the Carquinez Straits, on the Northern arm of San Francisco Bay. This bridge contains two cantilever spans each 1,132 ft. in length. The only longer cantilever spans are those of the Quebec Bridge, the Forth Bridge and the New York Queensborough bridge across the East River.

The most difficult problem was presented by the erection of the huge central pier acting as the support for one end of each of the cantilever spans. This pier stands in 99 ft. of water and is buffeted by two streams from California's great drainage system, the Sacramento and San Joaquin Rivers. The foundations of the pier are set in rock bored to a depth of 50 ft. The bridge is 350 ft. in height and 42 ft. in width, allowing four motor cars to pass abreast. Four years have been taken for the completion of this work.

Birmingham Water Supply

Since 1912 the Birmingham Water Committee have realised that some extra supply of water must be available for the city. The existing reservoirs in the Elan Valley are capable of supplying 36,000,000 gallons of water per day, and since the demand of the city is about 26,000,000 gallons per day this is, of course, ample. But the Elan Aqueduct, the connecting link between the Elan Valley and the Frankley Reservoir at the Birmingham end, is only capable of delivering at the maximum about 24,000,000 gallons.

In order to make the supply equal the demand, either the Elan Aqueduct must be enlarged or the Birmingham reservoir must be extended. As the length of the aqueduct would make alterations an expensive matter, the present Frankley Reservoir, having a capacity of only 200,000,000 gallons, is to be supplemented by the Bartley Reservoir, with a capacity of 500,000,000 gallons.

The site for the new reservoir is close to that of the old one and is covered with practically impervious red marl of considerable thickness, broken by beds of open red sandstone.

The reservoir has been made water-tight by boring holes 4 in. in diameter and 30 ft. apart along the centre line of the proposed embankment. Some 4,600 tons of cement were injected into these holes, where it spread out and formed a solid layer. In some places it was found that this method was not satisfactory, so trenches were cut and reinforced concrete utilised. The dam itself is being formed by an earthwork embankment thrown across the valley, the incoming water forming a lake behind it.

When completed the reservoir will be about two-thirds of a mile in length, one-third of a mile in width, and about 60 ft. in depth at the dam end, tailing off to about 5 ft. at the inlet end. The surface area will be 125 acres.

The two reservoirs will be connected with the Elan Aqueduct in such a manner as to make it possible to pump water into either of them independently of the other.

* * * *

Salmon River Power Development

An official report on the development of the Salmon River, Idaho, states that nearly 2,000 ft. of fall in the river may be utilised eventually. Nineteen power sites with a possible development of 84,000 h.p. for 90 per cent. of the time, or 114,000 h.p. for 50 per cent. of the time will be worked. If the river were regulated at certain storage sites, 119,000 h.p. could be developed for 90 per cent. of the time, or 175,000 h.p. for 50 per cent. of the time.

Painting the Forth Bridge

It is of interest to note that the amazing quantity of 54 tons of paint is required to cover the Forth Bridge. An area of 135 acres of steelwork surface has to be painted, and this takes about three years to complete, 55 men being employed during summer and about 45 during winter.

A Corporation's Meccano

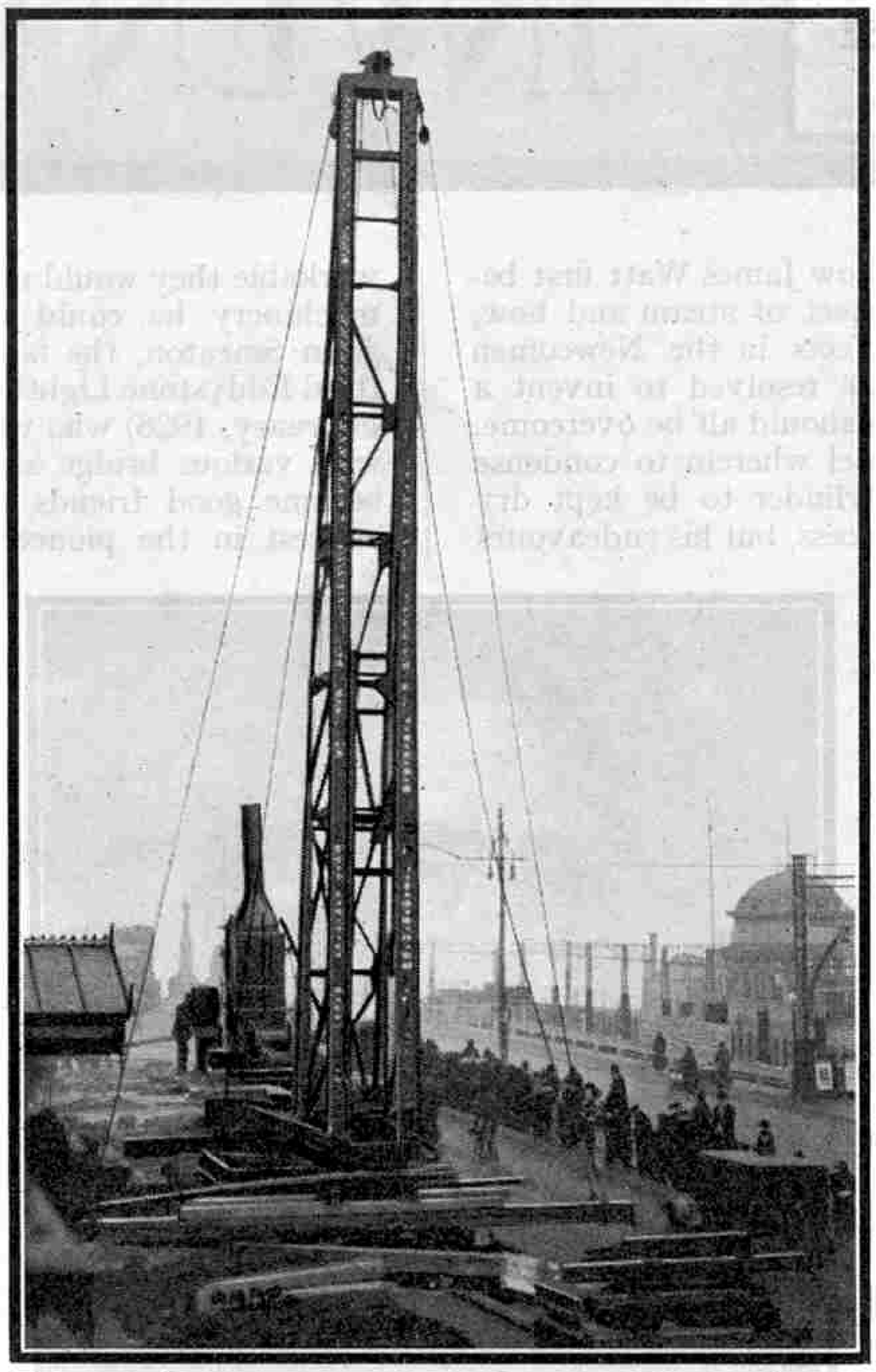


Photo courtesy] [*"Hastings Observer"*

Overheard in a Hastings Cafe :—"Well, shall we go for a walk along the top, or shall we go down to the front and watch the Corporation playing with their Meccano?"—From the *"Hastings Observer."*

* * * * *

What the Hastings Corporation are actually doing is to reconstruct a portion of the sea front. The operations are on a big scale and have been a source of great interest to the residents. The greatest attraction has been the pile driver, which is nearly 50 ft. in height and weighs some 80 tons. It is used for drilling large holes in the road into which will be lowered the girders that will support the new concrete foundations.

The drivers of vehicles are finding the operations something of a trial as the roadway is temporarily restricted to such an extent that there is no room to pass, and we agree with one of our readers (D. T. Regan, St. Leonards) who says that this is clearly a case of :—"Thrice is he armed who hath his quarrel just ; Four times he who gets his wheels in fust!"

Havre Port Improvements

Plans have been prepared for extensive improvements of the port of Le Havre. The new docks will be large enough to berth at the same time two of the largest vessels afloat. Any ship will be able to berth within a quarter of an hour after entering the mouth of the harbour.

Embankments Replace Timber Bridges

The Missouri Pacific Railway have now almost completed their scheme for the elimination of 47 timber bridges on the 96-mile stretch of their White River division through the Ozark mountain region of Missouri and Arkansas. These bridges have all been replaced by earth embankments and the change has been carried out with very slight interference with traffic.

The construction of the 269 mile stretch of the White River division was commenced in 1901 and finished some five years later. The country is very wild and it presented many serious engineering difficulties, the overcoming of which involved, among other matters, the construction of 57 timber bridges. The useful life of a timber bridge is strictly limited and ultimately there arrives a time when it becomes uneconomical to carry out the ever-increasing number of necessary repairs. This was the case with the White River division bridges, and in 1915 was commenced a big scheme of re-building or replacement. Ten bridges have been rebuilt while the remaining 47 have been replaced by embankments, the construction of which has involved the digging of 3,400,000 cu. yds. of earth from the surrounding hills, and the transportation of this for distances varying from one to 11 miles.

* * * *

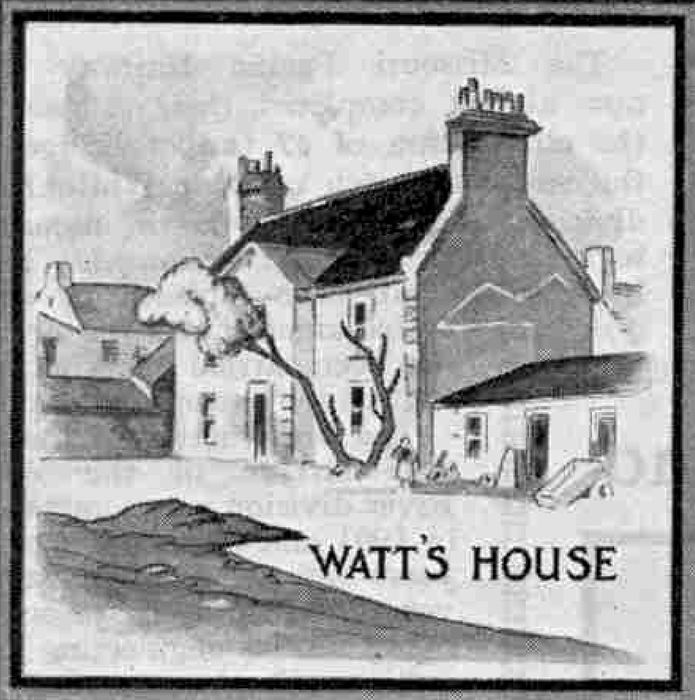
Extension of Appleby Steelworks

Considerable extensions have been made to the steelworks at Appleby, Lincs. The work, which has cost nearly £4,000,000, includes the erection of two new blast furnaces, bringing the total number to six. Each furnace is 80 ft. in height with a hearth diameter of 14 ft. 6 in. and is mechanically charged. The annual capacity of the complete plant when in full working order will be about 300,000 tons of pig iron and 300,000 tons of steel ingots. This material will be turned into steel plates of thicknesses ranging from $\frac{1}{8}$ in. to $2\frac{1}{2}$ in., for which purpose rolling mills—the first in the district—have been installed. These mills are operated entirely by electric power generated by waste heat from the blast furnaces.

* * * *

Southampton Dock Extensions

The contract placed by the Southern Railway for part of the Southampton dock extensions comprises the construction of increased quay space by setting forward the present quay front about 100 ft. A new quay about 420 ft. in length will be constructed of reinforced concrete wing piles and the mud between the old and the new walls will be removed. The space so made will be filled up with gravel and chalk, about 20,000 cu. yds. of filling being required.

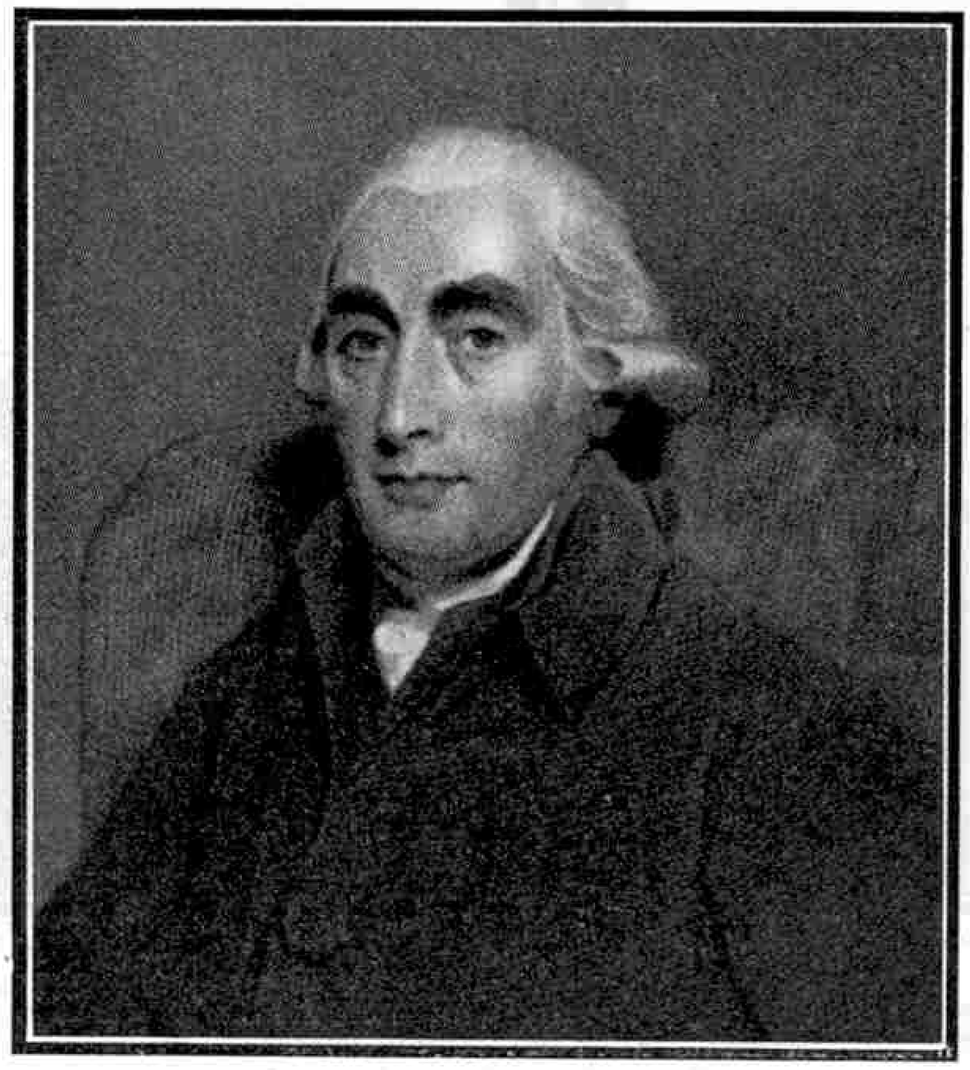


LIVES OF FAMOUS INVENTORS

II. WATT AND THE STEAM ENGINE

IN our March issue we related how James Watt first became interested in the subject of steam and how, after noting the many defects in the Newcomen atmospheric pumping engine, he resolved to invent a steam engine in which the faults should all be overcome. The adoption of a separate vessel wherein to condense the steam and so enable the cylinder to be kept dry and hot was a big step toward success, but his endeavours to build up a satisfactory working model were seriously hampered by the poor workmanship of the local whitesmith, upon whom he had to depend for cylinders.

Watt's fragile constitution and sensitive nature rendered him an easy and frequent prey to despondency and to his ever-present anxiety as to the success or otherwise of his invention was added an increasing worry to the accumulation of small debts that his experiments were incurring. From time to time his friend Dr. Joseph Black was able to lend him sums to defray some of these liabilities, but he realised that Watt needed a partner with means if the invention was to be brought to perfection. With this idea in mind Black decided to put Watt in communication with Dr. Roebuck at the Carron Ironworks: and so began a new chapter in Watt's life.



Dr. Joseph Black

Smeaton and Roebuck

Roebuck was a medical man who had early changed his profession in favour of that of an engineer, and in partnership with a man named William Cadell had started the first ironworks in Scotland at Carron in 1760. Having seen the Carron works through its infant struggles, Roebuck turned his attention to mining his own coal and to this end acquired extensive coal mines at Borrowstounness (or Bo'ness) in Linlithgow.

The mines were not doing well at the time on account of constant flooding of the greater part of the workings, and Roebuck realised that to render the pits more workable they would require the most powerful pumping machinery he could obtain. He therefore consulted John Smeaton, the famous engineer and builder of the third Eddystone Lighthouse (as described in the "*M.M.*," February, 1926) who was then in Scotland in connection with various bridge and canal schemes. The two men became good friends and Smeaton developed a keen interest in the pioneer work of the Carron Foundry.

The Newcomen pumping engines that Roebuck subsequently erected at Bo'ness proved incapable of mastering the heavy volume of water pouring into the workings. While seeking for some way out of this quandary Roebuck received a letter from Dr. Black telling him that a young mathematical instrument maker in Glasgow had invented a steam engine that easily outclassed the Newcomen pumping engine and, moreover, worked on a lower consumption of fuel.

One can imagine the eagerness with which the enterprising ironmaster got in touch with Watt. In the months that followed many letters passed between them, Roebuck ever urging the inventor to hasten the perfecting of the engine so that it could be adopted in the Bo'ness mines and to visit Carron for a talk on the matter. Watt had quickly sensed Roebuck's wholehearted interest and enthusiasm, and was wont to write at great length of his difficulties and frequent ill-health, as well as of his successes and new hopes. In reply to one of the ironmaster's characteristic, breezy letters Watt wrote: "You ask what is the principal hindrance in erecting engines? It is always with the smith-work." Nevertheless, the death of the local whitesmith, who had done his best to hammer out and solder together efficient cylinders, was a great blow to Watt and made him further pessimistic.

Roebuck felt confident that the skilled English workmen employed at his Carron works could cast and bore a cylinder, and offered to make the next one

required. At this Watt again took heart and on 10th November, 1765, sent to Roebuck carefully prepared drawings of a covered cylinder and piston, to be cast at the Carron Foundry. The cylinder was to be 2 ft. in diameter and to have an internal length of 7 ft. Watt had the piston rod made in Glasgow, where he was able to superintend the job personally, and on completion he had the unfamiliar piece of machinery carefully packed in a box for transport to Carron, fearing to send it through the Glasgow streets exposed lest the sight of it create a sensation among the public!

The completed cylinder duly reached Watt, but unfortunately it proved to be very crude and the bore was so sadly out of true that the casting had eventually to be discarded as useless.

Watt as a Surveyor

Watt's devotion to his steam engine had a bad effect upon his business of instrument-making and after the death of his partner Craig in 1765 or 1766 he finally gave it up. He had, however, to find some means of subsistence for his family and himself. His knowledge of mathematical instruments included those used by surveyors and, deciding that he would adopt their profession, he took an office in the city. He soon became proficient and secured several important commissions.

In 1767 he paid his second visit to London, this time to push forward an application for constructing a ditch-canal to connect the Forth and the Clyde by a route enabling advantage to be taken of Loch Lomond. The Advisory Committee of Parliament rejected the scheme, however, and Watt returned to Scotland feeling very angry at what he considered lack of foresight on the part of the Committee.

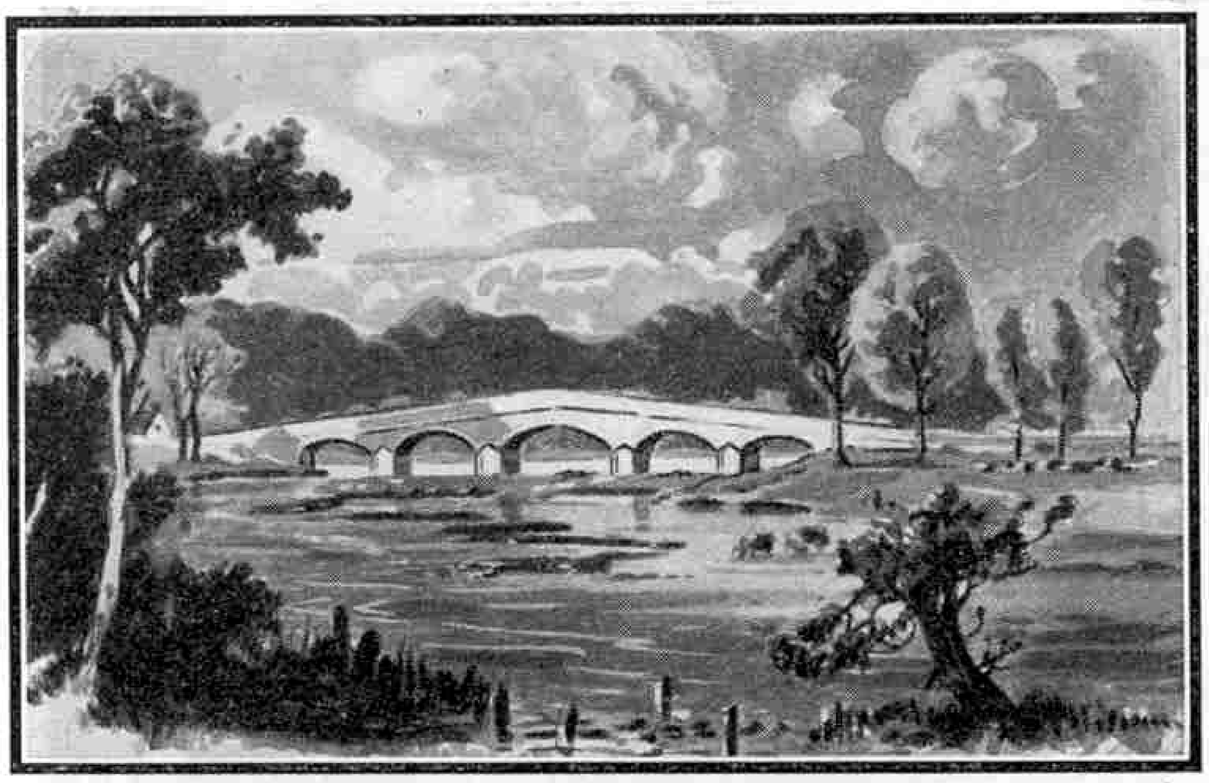
Referring later to his unsuccessful mission, Watt declared that he did not "wish to have anything to do with the House of Commons again," adding that he "never saw so many wrong-headed people on all sides gathered together!" At a later date the project was revived and a canal cut to a more direct route advocated by the engineers Brindley and Smeaton.

A Visit to Boulton's Works at Birmingham

During his return journey from London Watt visited Birmingham in order to call upon Matthew Boulton, the founder of the famous Soho metal works. Boulton was a close friend of Roebuck, by whom he had been offered a partnership in the Bo'ness coal mines scheme. Boulton's many interests, however, had deterred him from accepting his friend's offer.

Roebuck told Boulton of Watt's invention and what had been accomplished so far in bringing it to a practical stage. It so happened that Boulton himself at that time was studying the possibilities of steam and had built a model, on the lines of a Newcomen engine, with which he was experimenting. He was at once interested therefore on hearing of Watt's achievement and he expressed to Roebuck a hope that the young inventor would contrive to visit Birmingham in order that they might discuss the matter.

Unfortunately when Watt called at the Soho Works Boulton was away, but a friend of the latter, a physician named Dr. Small, courteously received the inventor and showed him around the extensive works. Watt saw there close upon 700 metal workers busily engaged in evolving artistic ware out of glass, stones and tortoise-shell. Candlesticks, brackets, urns, beautiful metal vases—some of them copies of rare works loaned to Boulton by wealthy collectors—and silver plate were included in the varied output. Two water-wheels were in use for rolling, grinding and polishing, and for turning various types of lathes. Boulton was led to study the possibilities of steam pumping engines on account of the difficulty during the dry summer months of maintaining a regular flow of water in the adjacent millstream to work large waterwheels.



Hamilton Bridge designed by Watt

Watt was greatly impressed by the activity and enterprise at the Soho Works, but most of all by the skill of the workmen and the excellence of the tools provided. There must have been a little envy in his heart as he recounted to Small the story of his invention and the many difficulties arising from the lack of skilled workmen in Glasgow. Small sought to persuade the inventor to remove to Birmingham and join Boulton and himself in building up steam engines on a large scale, but Watt could not then see his way to doing so.

The Bo'ness coal mines were becoming increasingly difficult to work and Roebuck felt that until Watt's more powerful engine was available, the effort to keep the pits comparatively free from water was a losing battle. Watt's slow progress in perfecting his steam engine was a sore trial to the waiting mineowner, who regularly wrote exhorting him to stick to the invention until he had got it to his satisfaction.

Roebuck had no doubts as to the ultimate success awaiting the steam engine, although his decision to enter into partnership while the invention was still in an experimental stage may have been hastened when he learnt of Small's offer. At any rate, an agreement was made between Watt and Roebuck shortly after. In return for a two-thirds interest in the invention, Roebuck took over all Watt's debts to Black, by then nearing £1,200, and undertook to finance the experiment until the engine was ready to patent, when he would pay the necessary patent fees.

In May, 1768, when a new model of the steam engine was in working order, Watt paid his long-deferred visit to Roebuck's residence, Kinneil House, Bo'ness, where he was very cordially received.

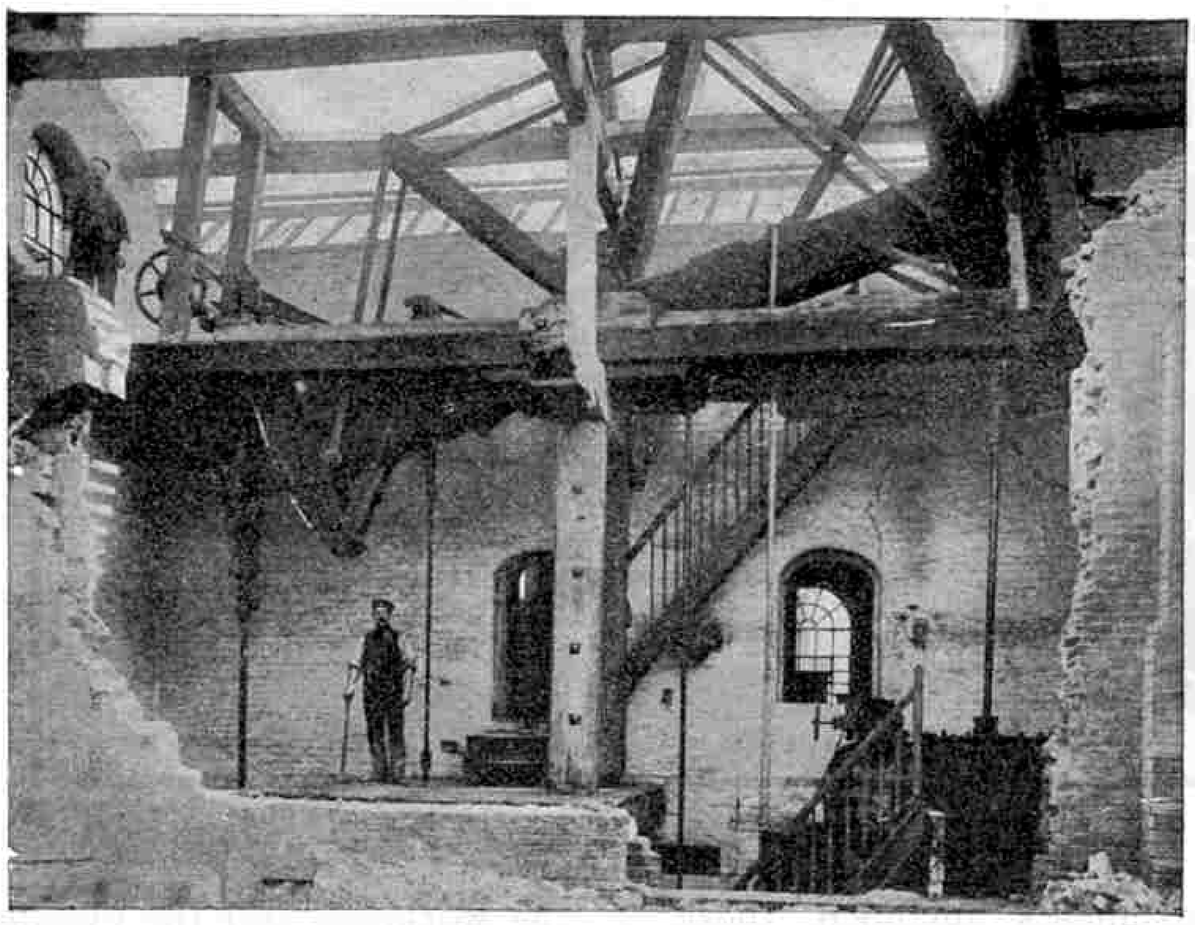
First Steam Engine Patented

Roebuck pressed for an early patenting of the engine, but Watt, acutely conscious of weak points in it and with his mind full of new ideas for improvements, was

somewhat diffident. Roebuck at length prevailed, however, and after securing a provisional patent at Berwick-on-Tweed, Watt journeyed to London in connection with the patent proper.

On his return north Watt again called at Birmingham, and this time was fortunate enough to meet Matthew Boulton. The two great men took an immediate liking to each other and Boulton's optimistic prophecies on the future of Watt's steam engine greatly heartened the sensitive inventor. From that time Boulton ceased experimenting with his own model until events should prove the success or otherwise of Watt's efforts. "In erecting my proposed engine," Boulton told Dr. Robison, during a visit of the latter soon after Watt, "I would necessarily avail myself of what I learned from Mr. Watt's conversation; but this would not now be right without his consent."

The drawing-up of the necessary plans and specifications of the steam engine was carried out during the ensuing months, in the intervals of Watt's professional duties. It was an anxious time for him, for he was continually pausing to try out something new and was greatly disappointed if it failed to work. Thus ideas for condenser pumps, double-cylinders, loading valves, oil pumps, pipe condensers, and many other parts of the engine were only committed to paper after rigorous tests. So prolific were these "brain-waves" that Roebuck began to have serious misgivings in regard to the invention ever becoming a patent! His fears proved unjustified, however, and in January 1769 the first practical steam-engine was patented. It is interesting to note that Richard Arkwright patented his famous cotton-spinning machine in the same year.



A Relic of the Past: One of Watt's early engines (1776) being demolished

(From the Editor's Book "Engineering for Boys," by permission of Messrs. T. C. & E. C. Jack, the publishers)

Trial Engine Erected

The early intention of the partners to erect a trial engine in the town of Bo'ness as soon as the patent had been obtained was now negatived by Watt, whose dislike of anything savouring of boasting rather carried him to the other extreme. Thus he decided that the engine should be built in an isolated outhouse behind Kinneil Manor. A stream passed through the glen in which Kinneil stood and skirted the outbuilding, so that a convenient and ample supply of water for the pumping engine was assured.

Roebuck loaned Watt a number of workmen, and of the necessary materials some were conveyed from Watt's place at Glasgow, and the remainder from Carron. The cylinder was cast and bored at Carron and was the largest Watt had so far used, being 18 in. in diameter and of 5 ft. stroke. The engine took six months to erect and, as the closing stages were reached, Watt's anxiety as to the outcome tortured him severely. Even minor delays or difficulties upset the fragile inventor, while the necessity of any unexpected expenses worried him for long afterwards, Roebuck's bolder and more optimistic temperament was a veritable anchor to Watt. To Dr. Small he wrote on one occasion "I have met with many disappointments; and I must have sunk beneath the burthen of them if I had not been supported by the friendship of Dr. Roebuck."

A Bitter Disappointment

The trial engine proved very disappointing, leakages of steam and faulty construction of the cylinder being the chief troubles. The piston absolutely refused to be rendered steam-tight and air-tight, despite Watt's efforts by wrapping it round with paper and oiled rags, tow, cork and even an old hat! Watt regarded the result of the six months' work with acute disfavour, described it as a "clumsy job" and was very much inclined to retire altogether from inventing steam engines. It was not his inventive genius that was at fault, however, but the workmanship of the engine, as we have seen.

The fruitless expense incurred distressed Watt most of all. To Small he declared: "You cannot conceive how mortified I am with this disappointment. . . . If I had the wherewithal to pay the loss I don't think I should so much fear a failure; but I cannot bear the thought of other people becoming losers by my schemes. . . ."

It was clear from the trial that the steam-engine was not yet ready for installing in the flooded Bo'ness mines. Roebuck meanwhile was feeling the strain of his costly efforts to render the mines workable and was no longer able to give Watt any financial aid. Indeed, he was compelled to borrow from Boulton the amount necessary to pay the patent fees for the steam engine, which he had undertaken to defray.

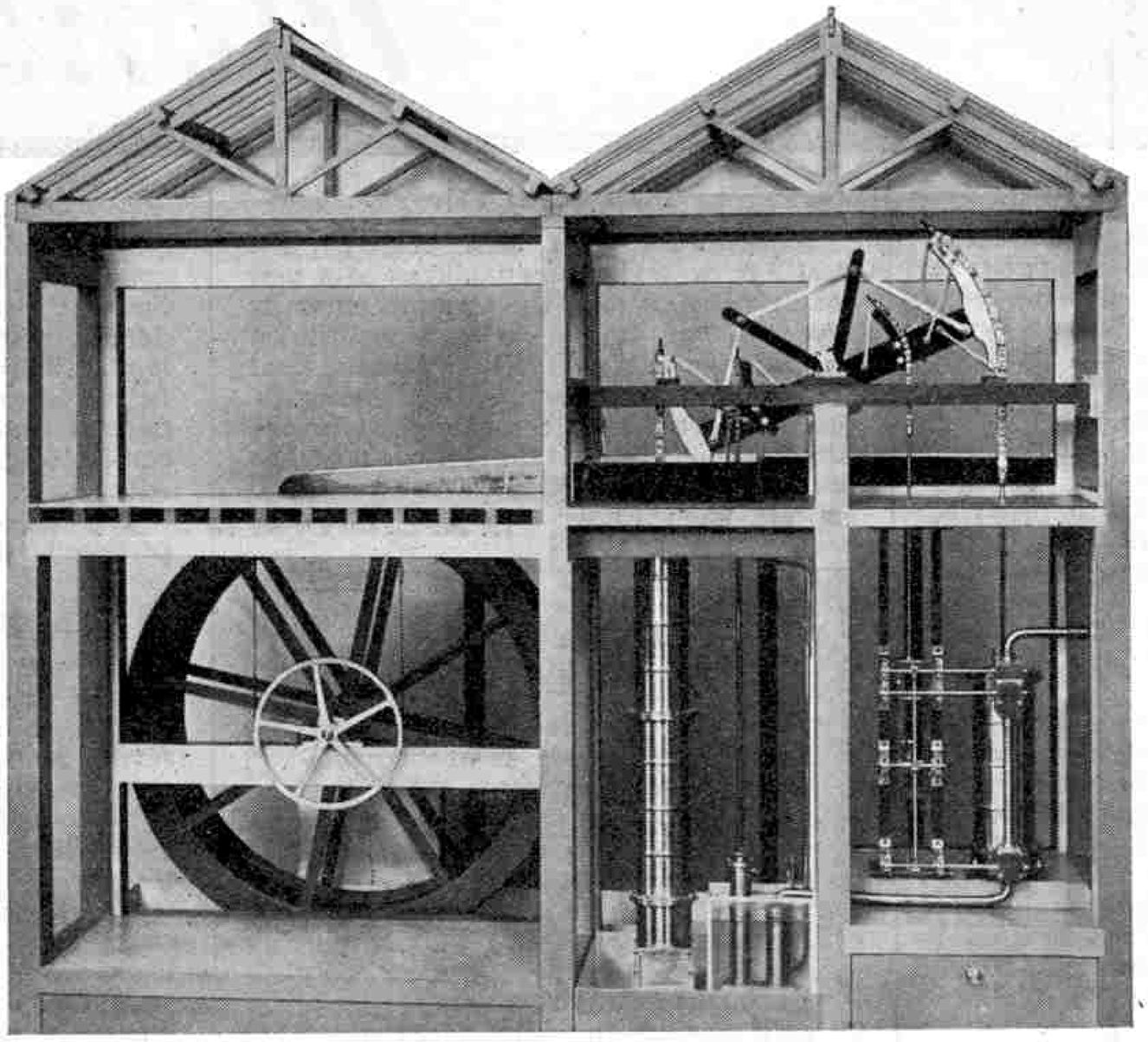
Watt, depleted alike in cash and enthusiasm, endeavoured to put the invention out of mind and turned his attention to his civil engineering. One of the first commissions he received was to survey a route for a coal canal from Monkland to Glasgow, for which an Act of Parliament permitting the waterway to be made was passed in the following year, 1770. Watt was then offered the position of Superintendent of Works at a salary of £200 per year and accepted the appointment.

Small greatly deplored Watt's suspension of experiments on the steam engine and besought him to send drawings of the invention to Birmingham, promising that an engine should be constructed at the Soho Works for exhibition. Watt had expressed a wish that the Soho partners would join with Roebuck and himself, but Boulton was not favourably disposed towards the idea. The Birmingham firm was experiencing a spell of bad trade and there was no surplus money to finance uncertain ventures. Moreover, Boulton had heard of the poor show made by the first patent engine, at Kinneil.

Second Attempt Fails

Early in 1770 Watt sent to Soho the plans asked for by Small. His interest in the steam-engine revived, and he made a further examination of the trial engine still standing in Roebuck's outhouse. The cylinder was removed and beaten true in shape. Being of a soft metal, however, it was liable to again be distorted by the action of the piston, and to prevent this two parallel planes were fitted, the piston being worked through these to diminish the vibration.

Finally the modified engine was tried, but unfortunately it was little better than before. Roebuck was greatly disappointed and Watt went away to his task of superintending the making of the Monkland Canal, all his former pessimism strengthened by the fresh failure of his invention. It is interesting to note that Watt christened the recalcitrant engine "*Beelzebub!*"



Photograph [*Board of Education*

Model of Watt's "Old Bess" engine (1777) now in South Kensington Museum

Watt's new appointment was altogether different from anything he had undertaken before and he found himself called upon to be superintendent, surveyor and treasurer, the staff appointed to assist him consisting of only one clerk! He lost none of his timidity and sensitiveness during the strenuous months that followed, but the outdoor life greatly benefited him physically.

Life as Canal Engineer

His numerous letters to Small during this time afford interesting insights into his tasks and experiences. In a letter dated 12th December, 1769, Watt says: "Now this canal is nine miles long, goes to a country full of level free coals of good quality, in the hands of many proprietors, who sell them at present at 6d. per cart of 7 cwt. at the pit. There is a valley from Glasgow to the place, but it has a rise of 266 ft. perpendicular above our river; I therefore set that aside, and have found among the hills a passage whereby a canal may come within a mile of the town without locks, from whence the coals can be brought on a waggon-way. This canal will cost £10,000—is proposed 16 ft. wide at bottom, the boats 9 ft. wide and 50 ft. long, to draw 2½ ft. water."

The necessity of bold dealing with various parties and of firmly governing the men under him is referred to in a communication he wrote some nine months later. "Nothing is more contrary to my disposition than bustling and bargaining with mankind;—yet that is the life I now constantly lead. . . . I have cut some more than a mile of the canal, besides a most confounded gash in a hill, and made a bridge and some tunnels, for all of which I think I am within the estimate, notwithstanding the soil has been of the very hardest, being a black or red clay engrained with stones. . . . Our canal is 4 ft. water and 16 ft. bottom. I have for managing the canal £200 per annum; I bestow upon it about three or four days in the week, during which time I am commonly very busy, as I have about 150 men at work, and only one overseer under me, besides the undertakers, who are mere tyros, and require constant watching."

In December of 1770 he wrote that "Notwithstanding the desperate weather I am almost constantly at the canal. . . . I have a hundred men at work just now, finishing a great hill we have wrought at this twelvemonth. The nastiness of our claygrounds is at present inconceivable; the quantities of rain beyond measure."

Although experiments with the steam engine stopped for the time being, Watt could not keep from inventing, and often his letters to Small would contain a brief description and sketch of some new mechanical device he had thought out.

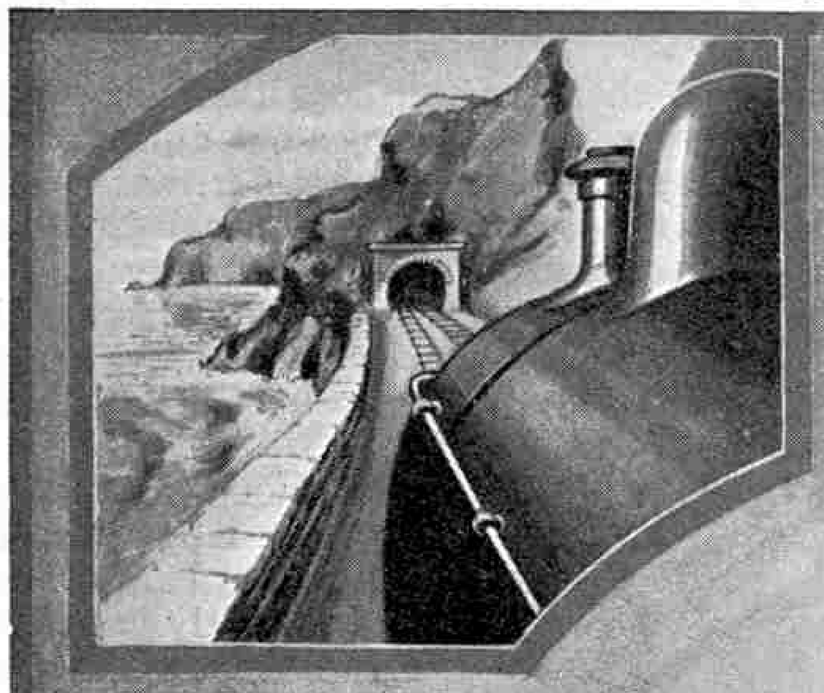
Of these various minor inventions, two that he carried to a practical issue and used to advantage in his survey work, were a telescope and a dividing screw, the latter an ingenious contrivance for accurately and equally dividing an inch into 1,000 parts. Another product of his fertile brain was a design for a muffle furnace for melting metals, and this he sent to Boulton at Soho, where doubtless the idea was put into use.

When most of the materials for the steam engine to Watt's plans were ready at Soho, Small wrote endeavouring to persuade the inventor to visit the works and superintend the assembling of the engine. The canal scheme demanded too much time, however, to make this possible.

Seven Guineas for a Bridge Design!

Watt carried out various surveys in the Western Highlands in addition to his work on the Monkland Scheme, and also made a survey for the Crinan Canal (later constructed by Rennie). Some of these tasks brought very poor remuneration. One such was a survey made for a canal between Perth and Cupar Angus, via Strathmore. This Watt commenced to make in September 1770, and completed 43 days later. Almost all the time he worked in blinding snowstorms and was chilled to the bone. When in due course he was paid for his trying task he received only eighty pounds—including expenses! A five-arch

(*Continued on page* 469)



Railway News of the Month

Scottish Notes

L.N.E.R. :—Among the engines recently scrapped or waiting to be scrapped at Cowlairs are: "D" class 0–6–0—9483, 9584, 1476, 9178, 9150; "E" class 0–6–0—10162, 10227; "P" class 0–4–4 T—9586, 9093/4; "R" class 0–6–0 T—10469; "R" class 0–6–0 T—1328.

The following have recently been through Cowlairs works: 4–4–2—9877, 9880/1, 9906; "Scott" 4–4–0—9413/6, 9423/5, 9899; "Glen" 4–4–0—9149 9258, 9287, 9298, 9408, 9490/5; "Director" 4–4–0—6381.

G.N.R. 4–4–0's—3054/8, 3062/5 are being overhauled and fitted with Westinghouse brakes.

Lined buffer beams are now a recognised standard for green engines and among engines recently repainted, including lined buffer beams, are 9902 "*Highland Chief*," 9490 "*Glen Dessary*" and 4–4–0 9731.

In connection with the Scotland-France Rugby International at Edinburgh, the following engines were observed on special trains:—*Arrival*—6379 "*Baron of Bradwardine*" from Glasgow and 9426 "*Norna*" from Aberdeen.

Return Specials from Edinburgh (Waverley)—6.10, 9363 "*Hal'o the Wind*" and 9417 "*Cuddie Headrigg*," (pilot, all diner train) for Dundee and North, 6.20, 6401, "*James Fitzjames*" to Glasgow. 6.40, 6399, "*Allan Bane*" to Dundee. 6.40, 9409 "*The Pirate*" to Glasgow. 7.00, 6395 "*Ellen Douglas*" (pilot) and 9900 "*The Fair Maid*" for Montrose.

The regular trains were—6.20, 6384 "*Edie Ochiltree*" to Glasgow. 6.31, 4–4–2, No. 9877 "*Liddesdale*" and G.N.R. 4–4–0 3055 to Dundee. 6.38, 6388 "*Captain Craigengelt*" to Perth. The "London" had 2577 "*Night Hawk*."

L.M.S.R. :—The all-Pullman train from Glasgow to Edinburgh was handled by McIntosh 4–4–0 No. 14364 (train engine) and another with a load equivalent to 12 bogie coaches.

* * * *

The L.M.S. have placed an order with the North British Locomotive Co. for fifty 4–6–0 three-cylinder engines complete with six-wheeled tenders.

* * * *

Watching the Wheels Go Round

In connection with a new picture entitled "*Speed*," a cinematograph film of the "*Flying Scotsman's*" wheels in motion has been made. The pictures were taken from the footplate of the engine, which was fitted specially with a projecting steel shelf to enable "close ups" of the wheels to be secured by a special camera, the drive of which was operated by compressed air.

The Caprotti Valve

Experiments have been held by the L.M.S.R. to test the capabilities of a new steam valve, named the Caprotti after its inventor, an Italian, who travelled on the engine under test. It is claimed that with this valve a considerable saving in fuel is effected, and the engine's effective life lengthened. On the occasion of the first test the locomotive hauled the 10.30 express from Crewe and also a special car fitted with various automatic instruments that registered every mile covered by the train. Engineers travelled on the footplate and were in constant touch with the experts in the observation car. A third observation post was in use and consisted of an improvised iron wind screen and tarpaulin sheet covering the buffer platform of the engine. The engineer occupying this position on the front of the locomotive doubtless did not enjoy his experience, for the average speed of the train was 54 miles per hour, while the conditions were bitterly cold throughout.

In a further test a train weighing 320 tons was hauled up the Shap 6½ mile climb in 10 minutes, although the gradient near the top is as severe as 1 in 60. Actually the train was four minutes late in leaving Crewe and arrived at Carlisle dead on time.

Difficulties Explained

4.—"S" ON L.M.S. ENGINE CABS

Several readers have enquired during recent weeks as to the meaning of the large letter "S" that appears on both sides of the cab of certain L.M.S. engines of the "Claughton" class.

The "S" indicates that the locomotive is a "star" or special engine that must be worked only by a particular driver and fireman, and during the time that these men are allotted to the engine nobody else is permitted to handle it.

Apart altogether from any question of sentimental pride in having the sole control of a "crack" locomotive, this system of reserving certain engines for special drivers must effect certain economies in operation. Engines resemble human beings. Each has its peculiarities, and the knowledge of those little internal differences enables the special driver to get more work from his "pet" than could be secured by a stranger.

C.N.R. Extensions

The Canadian National Railways are considering the construction of new branch lines in Saskatchewan and although no definite proposals have yet been adopted, it is anticipated that three new lines will be introduced in Northern Saskatchewan. Several other branches are also being considered to open up the mining areas of Alberta.

The estimated total cost of the schemes proposed is approximately £1,200,000.

* * * *

The Most Powerful Locomotive

In consequence of our article last month dealing with the Southern Railway's new passenger locomotive "*Lord Nelson*," several readers have written to ask whether this is really the most powerful locomotive in the country or whether there are other locomotives capable of handling heavier loads.

In our article it was made quite clear that the expression "most powerful locomotive" was in relation to passenger traffic only. Actually the most powerful engine in the country is the "Garratt" used by the L.N.E.R. for banking trains up the Wath incline near Sheffield. The tractive effort of this type of locomotive is approximately 56,000 lb. but its maximum speed is only about 10 miles per hour.

The most powerful engine of the tender type is the 0–10–0 banking locomotive used on the Lickey incline by the L.M.S. This engine has a tractive effort of 40,000 lb.

* * * *

French Railway Centenary

To commemorate the centenary of railway working in France, the P.L.M. Railway Company propose to place a tablet in the station of Itienne-Chateaux-creux.

The original French line was constructed in 1827 to trarsport coal from St. Itienne to the Loire, and was a single track 12 miles in length. There were 12 bridges and several cuttings and the wagons were drawn by horses. Passengers were first carried on the line in 1832 and steam locomotives were introduced 12 years later. Very little remains of the original railway and, as far as can be traced, a bridge, a platform and a station at Querilliere are the sole surviving relics.

* * * *

New Berwick Station

The construction of the new L.N.E.R. station at Parkway, at the north end of the Royal Border Bridge crossing the River Tweed, has been completed. The whole of the work has been carried out without interference with the train services.

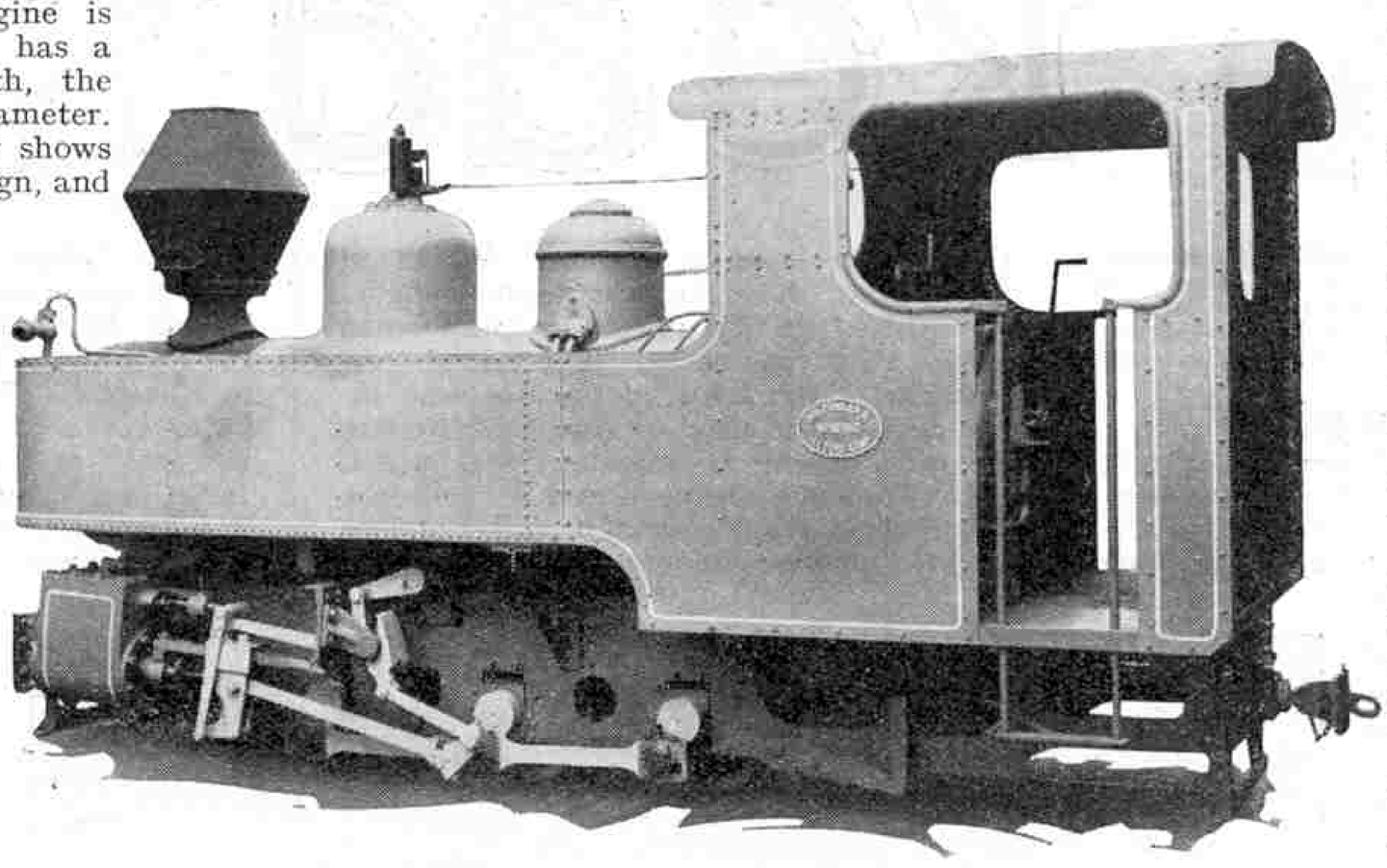
Light Engine for Work on Lincolnshire Farm

Our illustration shows an engine of an unusual type that has been built by John Fowler & Co. (Leeds) Ltd. for use on the estate of Mr. J. H. Dennis at Nocton, Lincolnshire. Its principal duty will be to haul potatoes from the fields and stores to the main line sidings. On a level track it is capable of pulling over 200 tons, while on a 1 in 40 gradient it can pull over 50 tons. The engine is of the 0–6–0 type and has a wheelbase 5 ft. in length, the wheels being 2 ft. in diameter.

The illustration clearly shows the peculiarity of the design, and it will be noted particularly that the frame is outside the wheels. Outside cylinders are employed, their dimensions being 8 in. diameter × 12 in. stroke. The valve gearing is of the Walschaerts' type.

The total heating surface of the boiler is 270 sq. ft., of which 28 ft. is attributable to the firebox, which has a grate area of 5 sq. ft. The boiler carries a working pressure of 180 lb. to the sq. in. and on the usual basis of 85 per cent. of the boiler pressure, this small engine has a tractive effort of 4,320 lb. Its weight in full working order is 11 tons 15 cwt. and it has a tank capacity of 250 gallons. The available bunker space is 15 cu. ft.

The locomotive has been built for a 2 ft. gauge track, laid with rails of a minimum weight of 20 lb. per yard, and a water-lifting device is fitted to enable water to be picked up direct from the river that runs through the estate.



An unusual engine for use on a Lincolnshire farm (*described on this page*)

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A New Starting Signal

Experiments have been conducted recently on the District railway with a new device for conveying the train guard's signal to the driver.

At each end of the platform are several rods connected up by a cable from which are suspended two wires running the complete length of the platform and electrically connected with a bell that rings at the driver's end. On giving the signal to start, the guard swings his flag staff so that a metal sheathing on the staff touches the two wires simultaneously and completes the circuit to set the bell in action.

If the experiments prove successful, and there seems to be little doubt as to the superiority of the system over previous methods, it is intended to instal the device throughout the line from Bow, in the East of London, to Acton in the West.

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Sudan Railway Extensions

The Government of the Sudan have granted authority to the Gedaref Railway Company to extend the existing railway from Nassala to Gedaref by the construction of 135 miles of single track. The authority granted covers a period up to 1962 and the estimated cost of the new developments is £2,560,000.

Millions of Tons of Coal Wasted

At a recent meeting of the Manchester section of the Institution of Civil Engineers an interesting paper on fuel economy, with particular reference to railway locomotives, was read. The lecturer, Mr. J. Bean, estimated that during the last 25 years the quantity of unconsumed coal in smoke-box ashes totalled approximately 85½ million tons, an average of about 3½ million tons per annum.

Great Western Notes

On the occasion of the Grand National Race, two notable runs were performed on the G.W.R. between Paddington and Birkenhead. Hauled by locos of the famous "Castle" Class between London and Shrewsbury (where the engines were changed) the entire run of 210 miles was accomplished in one case in 3 hrs. 50 mins., and in the other in 4 hrs. 1 min. Average speeds throughout were thus 55.9 and 53.7 miles per hour. In view of the many difficult gradients and slacks for junctions, collieries, etc., this work represents a very high standard.

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After the "Castles"

It is reliably stated that the celebrated "Castles" of the Great Western Railway will shortly cease to be the last word in Swindon practice, as a further type of 4–6–0 express locomotive is in course of preparation. The new locomotives will be named after Cathedrals, and will carry a boiler pressure of no less than 250 lbs. per square inch. Their advent will be keenly awaited, and it is interesting to note that the Great Western stud will then include "Castles," "Cathedrals," "Abbeys," "Saints," "Ladies," "Princes," "Princesses," "Kings," "Queens," "Knights," "Stars," "Waverleys," "Counties," "Courts," "Cities," "Flowers," and the numerous 4–4–0's bearing miscellaneous titles.

* * * *

The G.W.R. are experimenting with a vacuum-operated switch that automatically cuts off the battery used in connection with the automatic train control system when the engine is not under steam. The present system requires the battery to be in use even when the locomotive is at rest.

Leeds Notes

A recent football excursion express to Liverpool was hauled by a much-polished and decorated "Prince of Wales" loco (L.M.S.) The train consisted of new all-steel corridor coaches, and was much admired.

Liverpool-Newcastle expresses via Harrogate are frequently brought into Leeds (New) Station by L.M.S. locos of the "Prince" and "Experiment" classes. "Saracen," of the latter class, but rebuilt with Belpaire boiler and "Pop" valves recently gave place to No. 2404, "City of Ripon," a L.N.E.R. Pacific stationed at Gateshead, for the second part of the journey. Other expresses on the same afternoon were brought in by 5725, a "Prince" (painted black and unlined), and 992, a "19 inch" mixed traffic engine.

Expresses leaving for the L.N.E.R. line were taken by Class Z 4–4–2 No. 2207 (Express to Hull), Class R 4–4–0 No. 707 (Express to York and Scarborough), and old 4–6–0 No. 2006 (York and Newcastle). The latter engine bears the legend, "Paris Exhibition, 1900, Gold Medal," and a double replica of this medal is mounted on the driving wheel splashers.

At the Wellington Station (Midland Section), several of the old inside-framed 2–4–0's, rebuilt with Belpaire boilers and new pattern safety valves, were in evidence, including Nos. 207 and 242 (Skipton shed). Original 3-cylinder compounds Nos. 1002 and 1005 were also seen, the latter working a heavy Sheffield and Birmingham afternoon express. No. 1005 has been recently overhauled. Lancashire and Yorkshire 2–4–2 superheater tank engine No. 1173 (original number still carried) works local trains to and from Doncaster. Midland rebuilt 4–4–0 No. 448 left with a heavy Morecambe express, which was comprised of close-coupled six-wheeled carriages.

Many North Eastern locomotives, notably of 4–4–0 classes R and R1, work to and from Leeds Central station, mostly on Harrogate services. King's Cross expresses are mostly dealt with by Great Centrals of the 4–6–0 "Immingham" type, and Doncaster-built "Atlantics" and "Moguls." L.M.S. expresses to Liverpool, etc., are mostly hauled by L. & Y. pattern inside cylinder "Atlantics."

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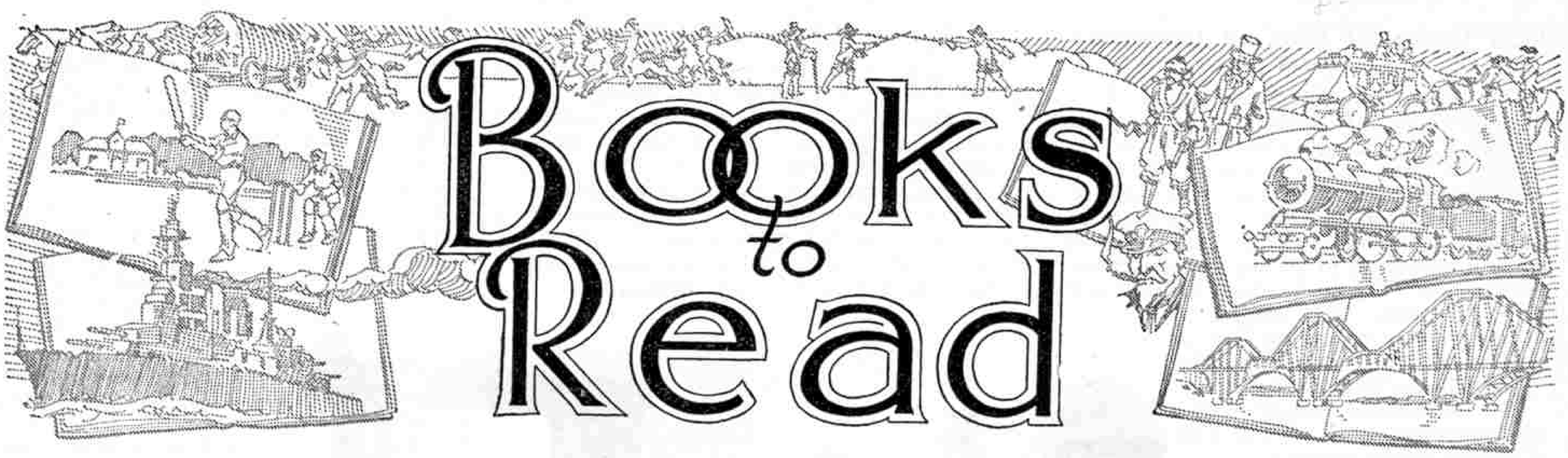
Continental Traffic Record

The remarkable growth of Continental traffic is illustrated by the announcement that 2,000,377 passengers were carried in 1926 by the Southern Railway's Continental and Channel Islands boat services, this number being greatly in excess of any previous figures set up by any railway having Continental connections. Actually the "two-millionth" passenger travelled from Victoria Station on 31st December.

It was only in 1920 that the million figure was passed, the number of passengers for that year being 1,194,257.



Readers frequently write to me asking if I can recommend books that are both of interest and of use. On these pages I review books that specially appeal to Meccano boys. I do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"The First World Flight"

By LOWELL THOMAS. (Hutchinson & Co. 24/-)

As is only to be expected, the narratives of the six Americans who flew round the world in 1924 not only makes a thrilling story, but also contributes much valuable information to the records of flying. Especially is this the case with the details of the exhaustive planning and efficient organisation that was required to bring the flight to a successful conclusion.

Of the eight airmen who set out, four succeeded in completing the world circuit and four failed. The flight started on the 6th April and finished on the 28th September, 1924, and the total distance flown was 26,345 miles. Although the total flying time was 363 hours 7 minutes, the flight took nearly six months to accomplish, for at every landing, time had to be spent overhauling and repairing the machines.

The machines used were "Douglas World Cruisers," and although the Americans admitted, when they met Locatelli in Iceland, that his Dornier-Wal flying-boat "appeared to be the most efficient 'plane for long distance flying that we had ever seen," the Douglas biplanes did all that was asked of them, even though they were nearly always heavily loaded and progress was therefore slow. For example, at Haiphong, in a dead calm on a river, it took one machine three hours to get off the water, and even then it could not take off until it had been taxied twelve miles down the river!

The "Liberty" engines did not stand up well to the strain. For instance, the first set in Lowell Smith's machine flew from Seattle to Japan, some 3,000 miles, and here a second set of engines was fitted. They, too, soon became defective, however, overheated and gave up altogether in French Indo-China when a connecting rod came through the crank case and a forced landing had to be made on a lagoon.

Then again, Nelson's machine developed a leaky cylinder after leaving Allahabad, and a new cylinder was obtained from the British store at Lahore. Whilst in flight near Karachi, this same engine commenced to fly in pieces from some cause that was never ascertained. At Karachi a third set of engines was installed and the machine reached Brough, England, where a fourth set was fitted.

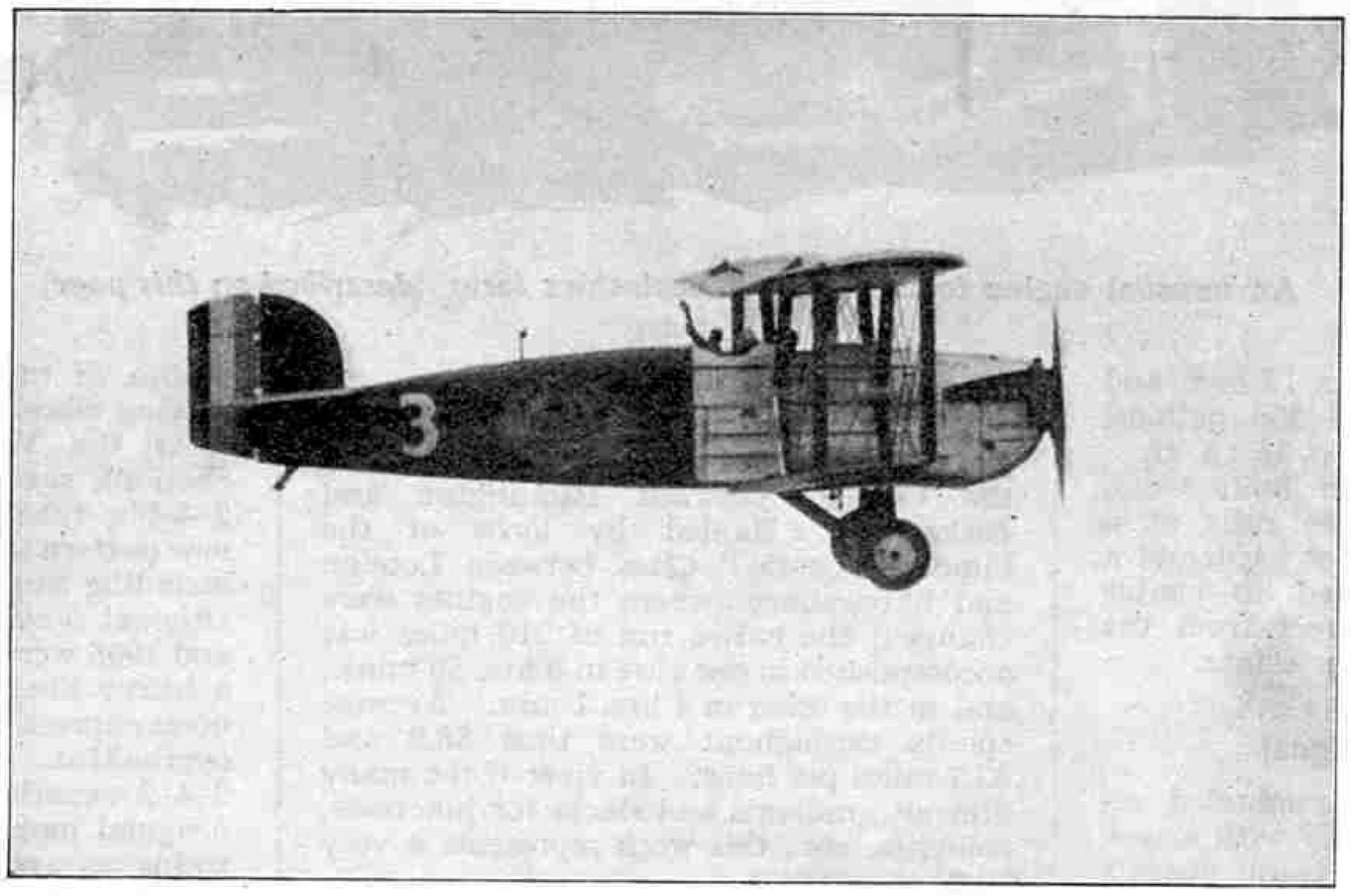
Between the Orkneys and Iceland the oil pump in Wade's machine failed and he alighted on a very rough sea. His machine was subsequently found and taken in tow by the U.S. cruiser, "*Richmond*," but was battered to pieces by the waves and sank.

The two surviving machines that managed to reach Greenland, had installed what was the fifth set of engines in one and the sixth in the other.

Before reaching North America Lowell Smith found his petrol pump and wind pump out of action and that an oil leak had developed, but by his companion working the hand-pump for three hours they managed to reach the coast. Ten miles beyond Baltimore the timing gear of the other machine slipped and the engine stopped dead. At San Diego the engines were changed for the last time, being the sixth and seventh sets fitted respectively. What a contrast this tale of woe presents to the record of the British-made engines that took Sir Alan Cobham to Australia and back after having previously flown to India and back, and to the Cape and back!

The flight started from Seattle and proceeded up the coast of Canada to Alaska (where Major Martin crashed into a mountain) and thence across the Pacific to Japan, China and through the East Indies across India from Calcutta to Karachi. Then, following the Karachi-Cairo route to Baghdad, across Europe by way of Constantinople, Bucharest, Belgrade, Vienna, Strasburg and Paris. The airmen landed in England at Brough and continued their flight northwest over Scotland to Iceland, the south coast of Greenland and across to North America, skirting the coast of which they passed Newfoundland, Boston, New York, Washington, and turned inland to Chicago, across the States to Los Angeles, San Francisco and so home again to Seattle.

Altogether the book makes excellent reading—there are many thrilling escapes, humour is not absent, and the 90 illustrations, from photographs of countries and cities on the route, show the wide variety of places and people encountered by the intrepid Americans.



"All the way across the English Channel Ogden wig-wagged to a neighbouring Pullman plane." One of the illustrations from "The First World Flight" reviewed on this page

* * *

"The Strength of England"

(Methuen & Co. Ltd. 8/6)

It has been more or less admitted in the past, and is appreciated also to-day, that the strength of England in time of peace lies in her ships. The author of this book maintains that this same maritime strength of England in wartime, consisting of a non-destructive and preserving pressure upon sea traffic, is the greatest security devisable by man. He proceeds to show how this strength came into being, and why, above all, it came to be centred in one small island off the coast of Europe, rather than in one of the great states of the Continent.

He records that a similar state of strength, a power both economic and military, has existed only at three different places upon the surface of the globe previously—Babylonia, Egypt and Rome. The conditions that enable such a state are a teeming population, overwhelming foreign trade, great riches and a wide-spread political dominion and power.

He explains that the chief power among nations has always rested by the sea-centre of the trading world, and that great international strength has always been accompanied by sea-centrality. This

position occupied by England alone was obtained as a result of many new discoveries made about the time of Queen Elizabeth. Then it was that our country became transformed from a strange and obscure island to the greatest commercial maritime dominion upon earth. The great change occurred in the 150 years between 1563 and 1713, the rise being more rapid than had ever been witnessed before.

It is interesting to learn that in Mr. Bowles' opinion this high place occupied by England need never be relinquished, provided that those in authority understand fully the problem that his book attempts to set out and to elucidate.

* * *

"The Twenty-Five Swordsmen"

By Escott Lynn (Chambers. 5/-)

To return to the workaday world after spending, in imagination, a riotous and adventurous life with the gay cavaliers, makes one very loath to part from such excellent company as the twenty-five swordsmen and their friends.

No reader of this book can fail to be infected with the spirit of the story and to share the experiences—grave and gay—of its characters. Basil Trenchard, worthy son of a noble English gentleman; the gay cavalier, Lovelace; with his companions Etherage of the quick tongue and sword, and Wilmot of the temper "too fiery for calm counsels"—as King Charles expresses it—seem indeed to be living people and no mere characters in a thrilling story of adventure. Troubles and reverses often come their way—and although Fate is not always kind to them they have good friends, as, for instance, honest Tom, Basil's servant, without whose loyalty and watchfulness young Trenchard would never have lived to thrill us as far as page 368 with his high adventures! Then there is the mysterious Colonel of the Roundheads—who, although belonging to the opposing army and a friend and confidant of Cromwell's, yet saves Basil and his friends on more than one occasion when death seems a certainty.

Naturally the story does not only concern admirable and brave characters. The villain of the piece is a rascally Puritan lawyer who would betray any cause for gold. We grind our teeth in impotent rage when time after time he escapes a just fate, and we experience considerable satisfaction when he is brought to heel at long last.

Sad it is to find that the cavaliers' finest efforts are useless and their fighting vain, since their King is beheaded. But the Swordsmen serve the King's son, and so gain fresh adventures and final triumph.

The author's name in itself is a guarantee of a good yarn, but perhaps because the characters of Puritans and Cavaliers are in such violent contrast and present such a foil for each other, or perhaps because stories of this period of history rank high in my list of favourite reading, I have enjoyed this book as I have not enjoyed a book for weeks—and I place it on record as one of Escott Lynn's best efforts.

* * * *

"The Seven Seas Shanty Book"

(Boosey & Co. Ltd. London. 5/- net)

This latest collection of sea shanties has been compiled by Mr. John Sampson and it has many good points. The shanties are sub-divided in capstan shanties, fore sheet shanties, halliard shanties, etc., and each one is given a short introduction describing its origin. Generally speaking the selection is good, and the versions of the words, although not always the traditional ones, are in most cases satisfactory.

The dark peninsula of Malaya, where the airmen encountered strange air currents. From "The First World Flight"

The shanties are arranged for piano by Mr. S. Taylor Harris, who in a prefatory note explains that his chief aim has been to leave the tunes unhampered by superfluous adornment, while at the same time affording a little help to the singer. He has succeeded to a great extent in doing this, but in many of the shanties there is a certain crudeness about his accompaniments that goes far towards spoiling the effect. From a musical point of view this collection suffers rather seriously by comparison with some of its predecessors, and the versions given of one or two of the old tunes are not at all attractive.

* * * *

"Readable Relativity"

By C. V. Durell, M.A. (G. Bell & Son Ltd. 3/6 net)

Books on relativity are usually either full of forbidding mathematical formulæ, or leave the mathematics out and concentrate on paradox. Mr. Durell's book is of a different kind altogether.

After a preliminary chapter on the progress of science, Mr. Durell proceeds to show what happened to Alice in the Wonderland of a world behind a convex mirror, where things are certainly not what they seem. The idea of this is to help the reader to be suspicious of some of his old fixed ideas, so that he will part from them easily. After that the real subject is tackled and in chapters on the velocity of light, clocks, and separation of events, the author leads up to the idea of time as a fourth dimension. The consequences of these new ideas are then traced out in application to the usual experimental proofs of the relativity theory, e.g. the bending of light in passing near the Sun.

The author believes that relativity can be made part of a general education, and no doubt, in time, the ordinary individual will obtain an idea of it just as easily as is the case at present with Newton's theories, so long described as laws. He has aimed, therefore, at giving a readable account of the easier aspects of the subject, and has produced a book which can be easily understood by, say, the pupils in the higher classes of secondary schools, or by anyone with a knowledge of elementary algebra. It can be recommended as a really useful introduction to the newest scientific views of the world.

* * *

"The Steam-Engine and other Heat-Engines"

By Sir J. Alfred Ewing, K.C.B. (Cambridge University Press. 25/-)

Those of our readers who are embarking seriously upon an engineering career will be interested to know that a new edition of this standard work is now available. In this edition—the fourth—extensive revision has been undertaken in order to bring the book up to date and many of the chapters have been practically re-written. Every type of heat-engine is dealt with in a comprehensive manner, an extraordinary amount of material being packed into the comparatively small space available.

In his preface the author states that the purpose of the book is to provide for the ordinary needs of university students of engineering and this object is achieved in a remarkably successful manner.

The book is well illustrated by four large folding plates and a large number of interesting diagrams. This is not a book for a beginner, but for a serious student it can be recommended unhesitatingly.

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"Romances of the Wild" *by* H. Mortimer Batten. 5/-

"Blackie's Boys' Annual" 5/-

"Field Astronomy" *by* D. Clark. 10/6

"Chemistry in the World's Work" *by* Harrison E. Howe (Chapman & Hall), 15/-

"Accumulator Charging" (Sir Isaac Pitman & Sons Ltd.), 3/6

"Mechanisms" (University Press), 3/6

"The Tale of Samuel Whiskers" *by* Beatrix Potter. (Warne), 2/-

"Metal Work" *by* H. M. Adam and J. H. Evans, A.M.I.M.E. (Arnold), 6/6

"Successful Crystal and One Valve Circuits" (Pitman), 3/6

"Morones of Mexico" (Labour Publishing Co. Ltd.), Cloth 4/6, paper 2/6

"The Wonders of Salvage" *by* David Masters. (The Bodley Head), 8/6

From Cowboy to College Student

A Red Indian who determined to "Live White"

By Chief Buffalo Long Lance

The following article, written by a Red Indian Chief, will I feel sure interest all my readers, for it tells how determination and ambition enabled Buffalo Long Lance to live like a white man and do a white man's work, instead of following in the uncivilized steps of his ancestors and of his tribe. We have to thank the Editor of "MacLean's Magazine," the leading Canadian journal, for permission to reprint this article.—EDITOR.

* * *

MISSIONARIES on a Blackfeet Indian Reservation in southern Alberta taught me my A B C's—but an old-fashioned bar-tender out in Wyoming first thrilled me with the idea that I might become educated and really make something out of my life.

Buffalo Long Lance, in the dress of a Chief of the Blackfeet Indians. This photograph was taken at a Blackfeet Sun Dance in Alberta

This man was a Pennsylvania Dutchman and so he happened to know about the Carlisle Indian School. He asked me one day when I was with a crowd of cowboys why I did not go to Carlisle and become educated. He explained that it was free for Indians.

"But I can't even speak good English," I told him.

"Well," he said, "you can educate yourself for entrance to Carlisle by reading. Read, read all the time—anything and everything you come across."

I was at that time sixteen years old and a full-fledged cowhand. Although I could break and ride bucking horses and ride almost anything that stood on four feet, I could barely sign my own name and spell out words.

I had just been "fired" from a ranch for losing my temper and striking a horse with my fist and I thought I was through with the white men. I thought they had mistreated me because I was an Indian. And that afternoon I bought an unbroken horse for seven dollars,* threw my tarpaulin over his back, in lieu of a saddle, and went north to the Indians, breaking him as I rode.

* (i.e.) about 35/-

Shortly after this I was included among a band of Indians selected to make a tour with Colonel Cody, who was known all over the world as "Buffalo Bill." We travelled widely for a year—I do not know where we travelled, as all cities looked alike to me then, but I often see places now where I know I have been before. I was still a boy, and my bobbed hair had again grown so that I could braid it.

"I Am Going to be Like That"

Something happened at the very beginning of this tour that had a tremendous influence on my life. One afternoon the chiefs and some of the older Indians were taken out to a wealthy and cultured home and some of us youngsters were taken along.

This was the first time I had ever met people of real culture and seen how they lived in their homes—and I liked them. They were different from any I had ever met. They had the dignity that the Indian likes, and they did not *yapiota*—talk too much. An Indian distrusts anyone who talks a lot. These people so impressed me with their bearing and their environment that I decided on the spot, "I am going to be like that."

Then it was that I remembered the bar-tender's advice, and on the strength of that and the smattering of the "three R's" I had learned at a mission, I began forthwith to read everything I could lay my hands on. I bought a dictionary to help me to translate the English tongue. I never passed a word in my reading without finding out its full meaning, with its principal synonyms and antonyms. By the autumn of 1909 I had prepared myself for entrance to the Carlisle Indian School.

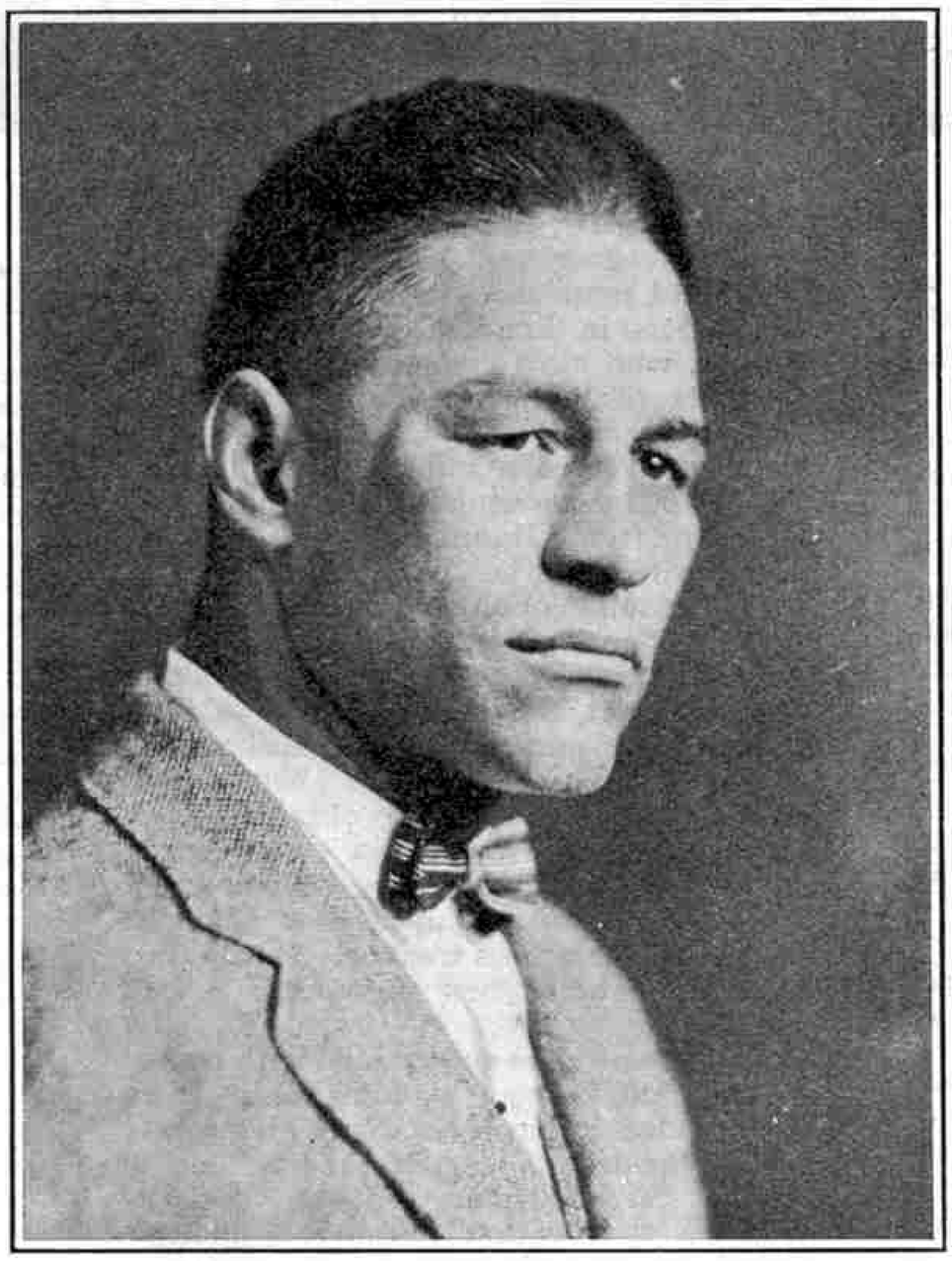
Experiences at the Front

Though I had a tremendous will to learn, my brain was as tough as raw buffalo meat when I arrived at this

famous old institution. I could not even get into the first-year class, but the instructors, evidently sensing that I was a willing student, put me into the class anyway, and sat up at nights teaching me " after hours." I was almost a hopeless case, but I had one faculty that saved me, and that was my thoroughness for learning every detail of a thing, and once learning it, never forgetting.

I skipped the junior class and graduated in 1912 as the honour graduate and valedictorian. Having gone into athletics to offset the indoor life and the mental strain of learning, I now found that it was possible to go on to higher schools on my athletic ability. I attended Conway Hall, Dickinson College, a year, and then received a scholarship to St. John's Military Academy, at Manlius, New York, where I took post-graduate work and graduated in 1915 with a silver medal for class and athletic honours.

At St. John's, old temper, which I thought I had conquered, popped up again one day, and I struck a fellow cadet. I was court-martialed and reduced to the ranks. At the time I was under appointment to West Point by President Wilson but I " flushed " the entrance examinations and decided that the best place for a chap who could not keep from disgracing himself and his friends was fighting under the colours of an army that was upholding a world cause.



Chief Long Lance as he appears to-day

So back west and north I came. Three weeks after I had " coughed " and said " Ah-h " and " Ninety-nine " for the medical officer, I was on my way to France on the " *Olympic*," as " Sergeant B. C. Long Lance, C. Company, 97th Battalion, Canadian Expeditionary Force."

What college did not teach me about holding my temper, the war did. After seeing men lacerated day in and day out intermittently for nearly three years, the vengeful ego in me disappeared. It has been supplanted by a desire to fight only for things big enough to be a principle of protection to others.

" You'll Go Back to the Feathers "

When I returned from overseas in 1919 and got my discharge in Calgary, I walked out of the barracks wearing civilian clothes for the first time in ten years. In fact, they were about the first civilian clothes I had ever worn ; for before I had gone to the military schools, about the nearest I had got to white civilian clothes was a wide-brimmed, two-gallon hat.

My real problem was : What was I going to do with myself ? I knew absolutely nothing about earning a livelihood. All I knew was arts and science and how to construct trenches for warfare. I had entered school, ten years before, an immature cowboy, not knowing even the rudiments of that " profession." I had emerged from the kaleidoscopic whirl of college and war, an educated person with a white man's brain—yet an Indian. And I was three years behind time—years that were more valuable to an Indian trying to fight his way from college into civilization than to a white college man who returned to a civilized home, friends and prospects of a position.

The day after I got out of the army I met Major C. W. MacInnis, of Edmonton, former chief intelligence officer of the Canadian Forces with whom I had worked after being disabled by wounds. We met on Eighth Avenue, Calgary. He said : " What are you going to do now, Chief ? "

" Oh, I'm going to get a job somewhere and carry on."

" I'll make you a bet," he said. " I'll bet you a hundred dollars that two years from now you'll be back into the blanket. I'll just give you that amount of time. You might think you are going to stick it out, and you may stick it a year. But I know you better than you know yourself. You are going to get disgusted and go back to the feathers, and the Indian reservation."

Looking for a Job

That was the best thing that anyone could possibly have said to me. In athletics I always had fought better in the opposition's territory. To be against me was to be with me. So now I had the Major to game with—I'd show him !

I looked around Calgary, and found it was jammed with soldiers out of work. The Department of Soldiers' Civil Re-establishment said that they would put through an application for admission to a university so that I could finish my college work. I made out the application and forgot about it.

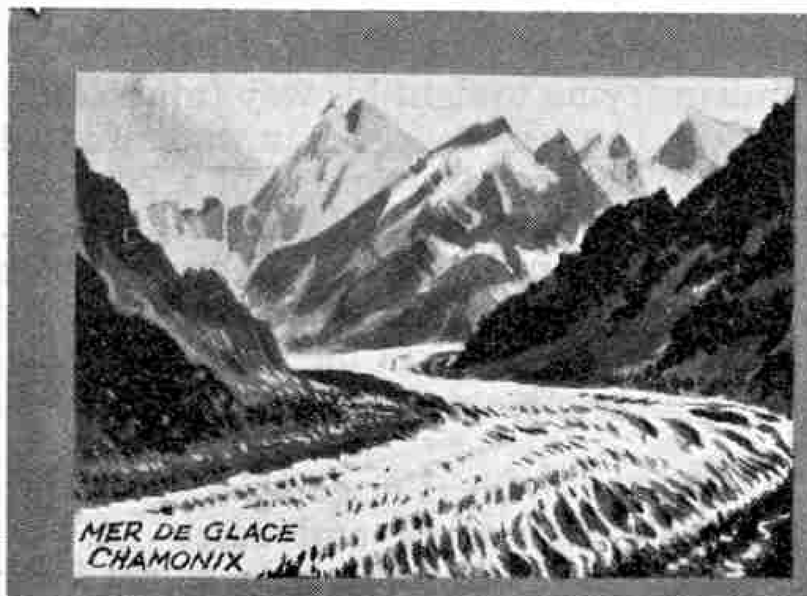
Then, I remembered the one thing that I could always fall back upon, professional athletics. I had boxed successfully in the army and I decided to go down the Pacific Coast and become a professional boxer. I went to Los Angeles, and on my way down was singled out on the train by a boxing promoter, who immediately took me under his wings—once a boxer, one can never conceal the fact afterwards, for some mysterious reason.

Boxing and Journalism

Arrived at Los Angeles, I was introduced to another promoter who, after watching me do my stuff, offered to match me against the middleweight champion of the Pacific Coast for $500. But it was not to be. The next morning I received a letter from the D.S.C.R. at Calgary, informing me that my recommendation for a journalistic course at one of the universities had gone through, and instructing me to report immediately.

The next morning I cancelled the fight engagement and started for Calgary. When I arrived the D.S.C.R. informed me that I could either go to college and learn journalism or be placed on a newspaper. I chose the latter and was started on the Calgary " *Herald* " at ten dollars a week.

I would still be on the " *Herald*," no (Continued on page 455)



Our Wonderful World

Helium for Divers

Experiments recently made in America have revealed a new and somewhat surprising use for helium which, until recently, has found very limited application only in the filling of airships. The gas has now been found to be of great value to divers, assisting them to avoid their greatest danger.

A diver incurs little risk in his descent to ocean depths, but on reascending great care is necessary. While he is under water, air is supplied to him under pressure, with the result that nitrogen is dissolved in his blood to a greater extent than normally, and if he reascends too quickly the nitrogen may be released in bubbles. The result is what is known as caisson disease, from its first occurrence among the men who worked in compressed air in the caissons used in the construction of bridges. The disease is very unpleasant and may be fatal if the bubbles are formed in the brain or spinal column.

A great deal of trouble through caisson disease was experienced by the workmen engaged in the construction of the Forth Bridge, for instance, as described in the article on that bridge in the "*M.M.*" for November 1925. The only method of treatment available in those days was recompression in one of the air locks, followed by a very slow reduction of the pressure.

An improved method of treatment is now available. By using a mixture of helium and oxygen, instead of ordinary air, there is less danger of the formation of bubbles, as helium is much less soluble in the blood than nitrogen. The return of a diver to a normal state thus can be brought about much more quickly and with greater safety.

If divers could be supplied while under water with the mixture of oxygen and helium, longer periods of work at greater depths would be possible, but unfortunately helium is rare and costly and its general use by divers when working is impossible.

* * * *

One Disease Made to Cure Another

To cure a patient of one disease by giving him another seems a very strange method, but it is one that has actually been used in recent years. The disease cured is general paralysis and the curing disease is malaria. The advantage gained is that the former disease is incurable by any other known method, while the latter is nowadays easily dealt with, although it has caused immense suffering to whole nations in the past, its ravages being one of the causes of the downfall of the Roman empire.

The malaria method was practised by a Frenchman, Dr. Legrain, as early as 1913; by Dr. Wagner von Juragg in Vienna in 1917, and more recently on a larger scale by doctors in London, Liverpool and in France, who have given very encouraging accounts of its value. In England the patients suffering from general paralysis have been given a mild form of malaria conveyed by mosquitoes that had been collected from Romney Marsh and infected with malaria.

The results obtained in the London County Council Asylum where the method has been tested show that, as a result of the treatment, one in four of the patients has recovered sufficiently to be discharged, as against a previous rate of about one in 50. The best results were obtained when the disease was treated in early stages, definite improvement being shown under these circumstances in no less than 60 per cent. of the cases treated. It will thus be seen that the new method is full of promise.

No fears need be entertained with regard to the mild form of malaria used. Even the dreaded tropical malaria is giving way before the attack of the experts, one of whom, Sir Malcolm Watson, declared recently that within four years malaria would be an unknown disease as far as Singapore was concerned and that within ten years mosquito nets would become unnecessary. This statement was made at a reception given in honour of Sir Ronald Ross, whose discoveries in connection with this disease are calculated to have saved about 100,000 lives in Singapore since 1912.

* * * *

The Increased Value of Platinum

Seventy years ago platinum was so abundant in Russia that it was regarded as a cheap substitute for gold, and it was used in the minting of twelve-rouble pieces, coins equivalent at that time to about 25/– in English money. Now one of these coins has just been sold for £35 10s. 0d., a very remarkable instance of the increased value of the metal at the present day.

The principal cause of the rise is the cessation of platinum mining in the Ural mountains in Russia where, in pre-war days, practically the only productive platinum mines in the world were to be found. The present state of affairs may not last long, however, as platinum has been discovered in the Transvaal, and there is always the possibility of the resumption of production in the Russian mines. A drop in price would be welcomed in scientific circles, as the metal is of great value in the making of crucibles and other apparatus, on account of its resistance to corrosion and its very high melting point.

Fishes that Eat Men

It is a common reproach to indolent people that they are cold-blooded like fishes, but this is hardly fair to the fishes, some of which are remarkably energetic and ferocious. The man-eating shark is one example, but even it is out-done by the pirana, a little fish not more than eight inches in length, that is to be found in eastern Bolivia in South America. This water-wolf seems to scent blood a long way off and will attack without hesitation any living being that enters the water, tearing the flesh from the bones!

An Englishman who has recently returned from Eastern Bolivia saw a native fall from a canoe into the water and was amazed to see such a swarm of piranas attack the poor fellow that within five minutes nothing was left of him but his skeleton. The only good things that can be said about the pirana, from the point of view of a human being, are that it is good to eat and yields a valuable oil.

* * * *

How the Alps were Made

The latest ideas of the manner in which mountain ranges were formed are somewhat startling. It is supposed that the Alps, for instance, were the result of movements of Europe and Africa towards each other, the material lying in between these two continents being pushed up to form this range.

Strange as it may seem, this statement is perfectly sound from a scientific point of view, for there is a good deal of evidence in support of the idea that all the continents are afloat on a liquid layer within the earth, and that they have slowly changed position during geological periods, and may still be moving. One way of testing this is to determine the longitude of points on various continents from time to time, as this gives the angular distance of these points from Greenwich and from each other. If the continents really are moving, the longitude figures will obviously show slight changes, and by very careful and exact measurements repeated at intervals over a number of years it is hoped to throw some light on this very interesting suggestion.

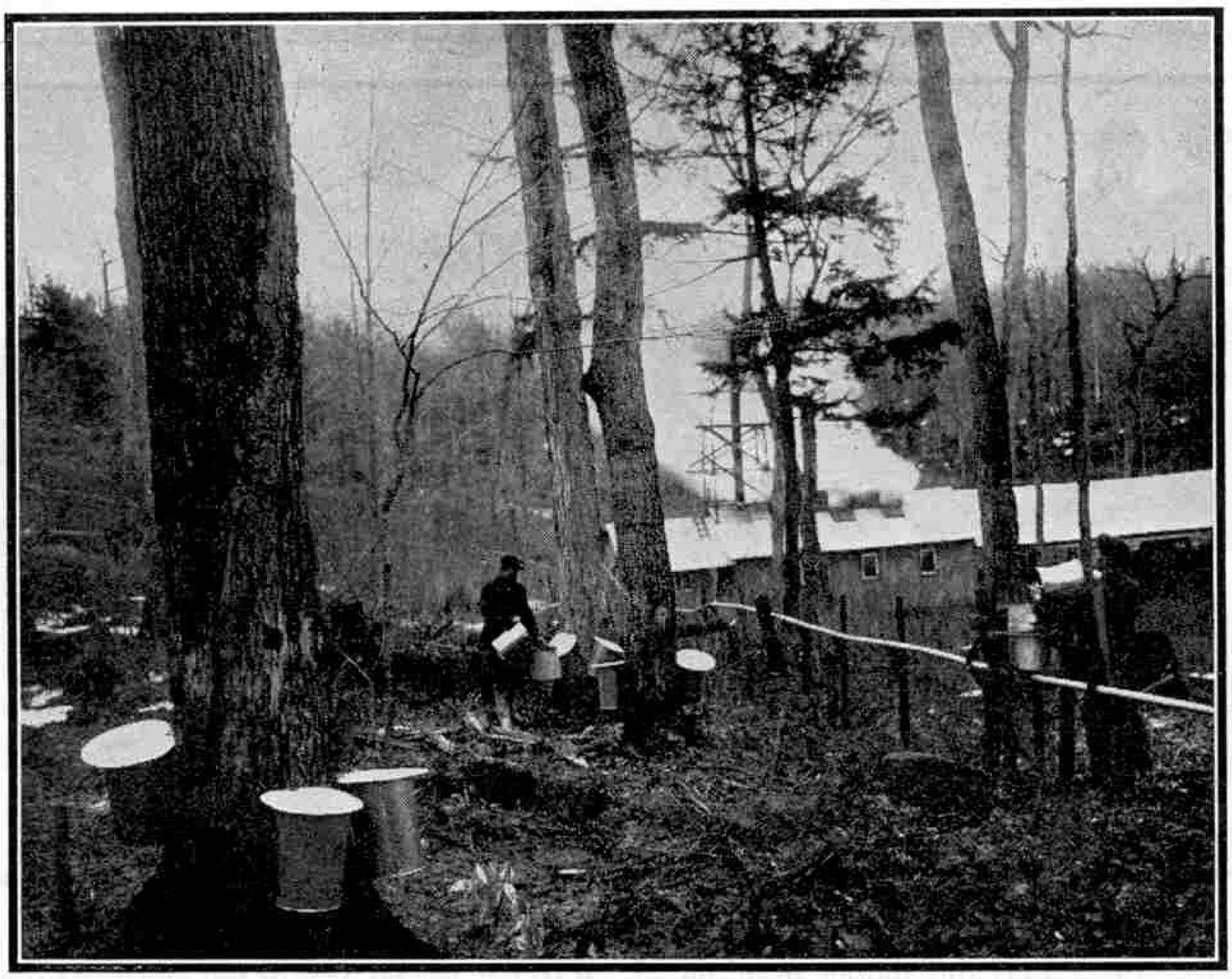
Three stations at which measurements of this kind are being made are situated at Shanghai, Algiers, and San Diego in California, these three being eminently suitable for the purpose on account of their situations in three different continents and their distance apart.

We hope shortly to refer in more detail to this remarkable suggestion that the continents are only gigantic rafts. It is supposed that they are the fragments of a single continent that comprised the whole of the land above sea level.

A Mystery of the New World

The recent explorations of Mr. Mitchell Hedges and others in Central America have drawn attention to an unsolved problem. This is the origin of the civilisations that existed in Central and South America long before the time of Columbus. The mystery lies in the fact that no traces have been discovered of the growth of the highest form of civilisation in the new world, that of the Mayas, which seems to have sprung into existence fully developed. This is hardly likely, but the problem of its origin and growth has so far eluded solution.

Very little is known of the history of America before Columbus "discovered it." The Vikings had already reached America 500 years previously and had probably penetrated as far south as the site of the present city of New York; while the Chinese claim that they had discovered it centuries before that. The Vikings as a source of the civilisation of Central America may be ruled out, but the view that this has an Asiatic origin is supported to some extent by the legends of the Chinese.



Gathering sap in a maple-sugar forest (*see article on page 386*)

Recent discoveries in Alaska seem to show that the inhabitants of North America at any rate entered the continent from the West. A passage from Asia to America could of course be made quite easily by way of the islands in the Behring Sea, and there are distinct signs that Sitka, an island off the coast of Southern Alaska, and a small island off Siberia, were temporary stopping places in a migration from Asia to America. In California, too, traces of Asiatics have been found. The Chumash, who occupied that State in prehistoric days, survived to modern times practically unchanged. Even to-day one of them is still living and it is easy to see that he is not an American Indian in type but rather resembles the yellow races of Eastern Asia. It has been found that among these early colonists a stone top was used in a gambling game that is exactly like one common in Burma and India.

The most striking proof of the connection between the old American civilisation and Asia is to be found in some drawings made 90 years ago by a French artist named Waldeck. These, he asserted, were made from carvings that he had seen in the ruined Maya city of Palenque in Central America, in the district in which Mr. Hedges is now working. The drawings distinctly show elephant heads, which gave rise to the belief that the artist had allowed his imagination too much scope, for no live elephant ever existed in the new world before its discovery by Europeans. Recently, however, all doubt as to the genuineness of the drawings has been removed, and other carvings showing elephants have also been discovered, so it is certain that the Mayas knew something about these animals. These discoveries give strong support to the view that the American civilisation was Asiatic in origin. The idea of the colonisation of America from Asia by way of Alaska or the South Sea Islands is somewhat surprising, but investigations of religions and folk-lore have resulted in the production of supporting evidence.

* * * *

Is Earth Slowing Up?

Astronomers are now engaged on a series of tests that, it is hoped, will reveal whether there is any variation in the rate of the earth's rotation.

Every night a few minutes before eight o'clock time signals are broadcast from the powerful wireless station at Bordeaux. Astronomers in different parts of the world will carefully note the exact time they receive these signals, and the differences between the Bordeaux time and the local times at each observatory, converted into degrees at the rate of 15 degrees an hour, should correspond to the differences in longitude.

Should any discrepancies show themselves when, at a later date, the experiment is repeated, they must be due either to an actual change in the rate of the earth's rotation or to movements of the earth's crust, which produce changes in longitude.

The first series of tests will last thirty days, and the Bordeaux signals will be recorded in observatories in Europe, Asia, Africa, North and South America, and Australia.

There is some reason to believe that the earth is turning slower than it used to do, but as the variation is less than the 200th part of a second in a century it is not expected "*M.M.*" readers will worry!

Hunting Lost Radium

The authorities of Charing Cross Hospital received a severe shock one day in February. Their entire stock of radium had disappeared! It had been used in the operating theatre, but when the assistants looked for it afterwards to place it in safety it could not be found anywhere.

This was a serious matter. The whole of it was contained in two short tubes, each about as thick as a lead pencil, but its value was about £1,500. Apart from the monetary value there was a doubt whether it could be replaced at all, for the amount of radium in the world is very small indeed. Actually many hundred tons of ore are necessary for the production of an ounce of radium, and the extraction requires the labour of 500 men for six months. A thorough search was made for the missing material, and finally it was discovered in some pieces of clinker brought from the stoke-hold under a destructor fire.

Great interest attaches to the method of discovery. It must be remembered that the tubes containing the radium would have melted, and the radium after passing through the fire would be practically indistinguishable in appearance from the ashes. Further, the amount of it was only a fraction of an ounce, so that to look for it in a mass of burnt refuse would have been much worse than looking for the proverbial needle in a hay-stack, if it were not that the peculiar properties of the radium remained unaltered by its fiery ordeal. The detectors used in finding radium in such cases make use of these properties. One form utilises the fact that air in the presence of radium becomes a conductor of electricity, while the one used in the case of the Charing Cross Hospital search takes advantage of the glow produced in some mineral substances by the rays given off by radium, a process similar to the use of fluorescent screens for the detection of X-rays, as explained in our recent Electricity articles. The radium thus recovered has been carefully purified once more and is as good as ever.

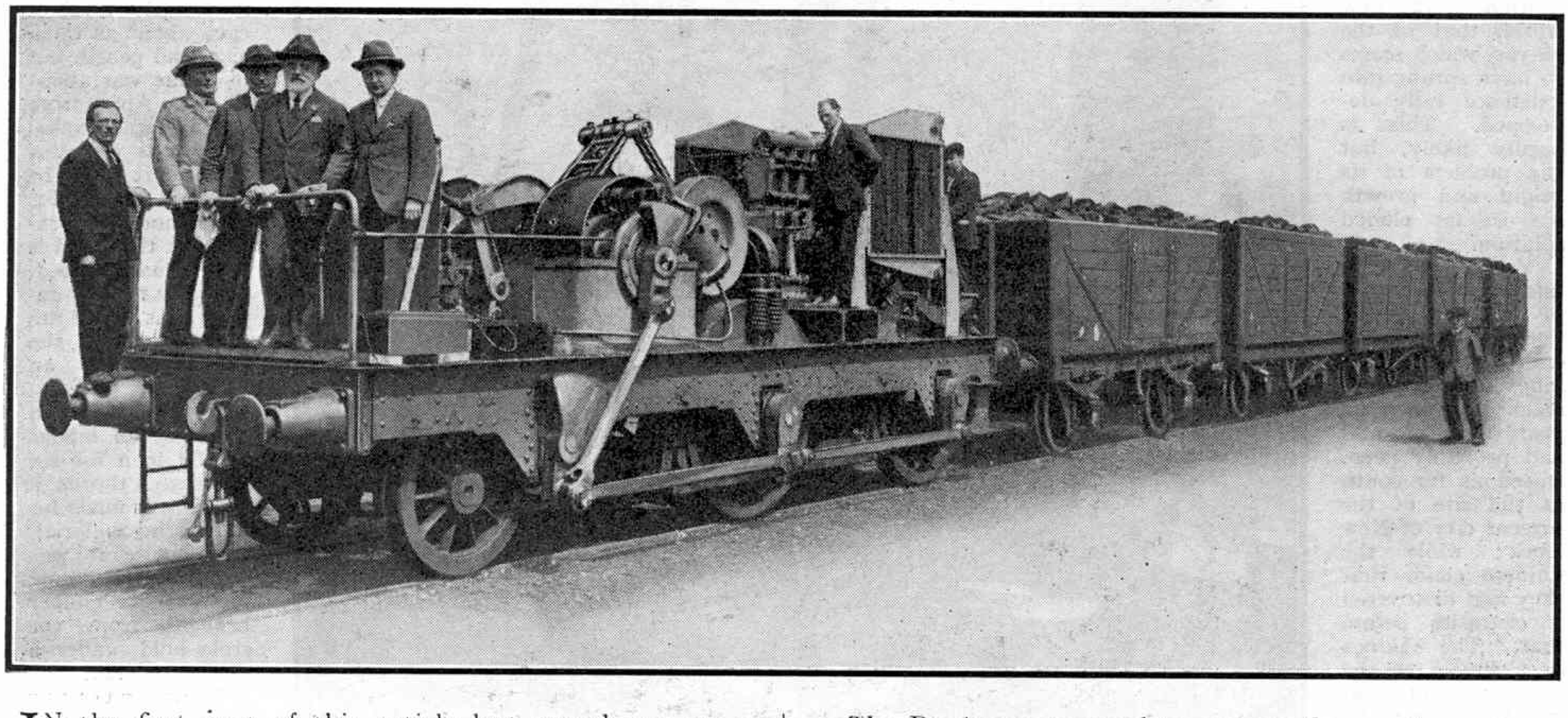
* * * *

The Return of the Buffalo

The buffalo has come to life again! This magnificent prairie animal, that figures so largely in the tales of the pioneer hunters of the American plains, seemed doomed to extinction when, in 1907, the Canadian Government bought a small herd and turned it into a "park" of 160 square miles near Wainwright in Alberta. The herd has now increased to 6,000, and although many have been slaughtered it has been found necessary to establish another and larger buffalo park on the Slave River in the north of Alberta.

Motor Cars Without Gears

Success of the Constantinesco Torque Converter

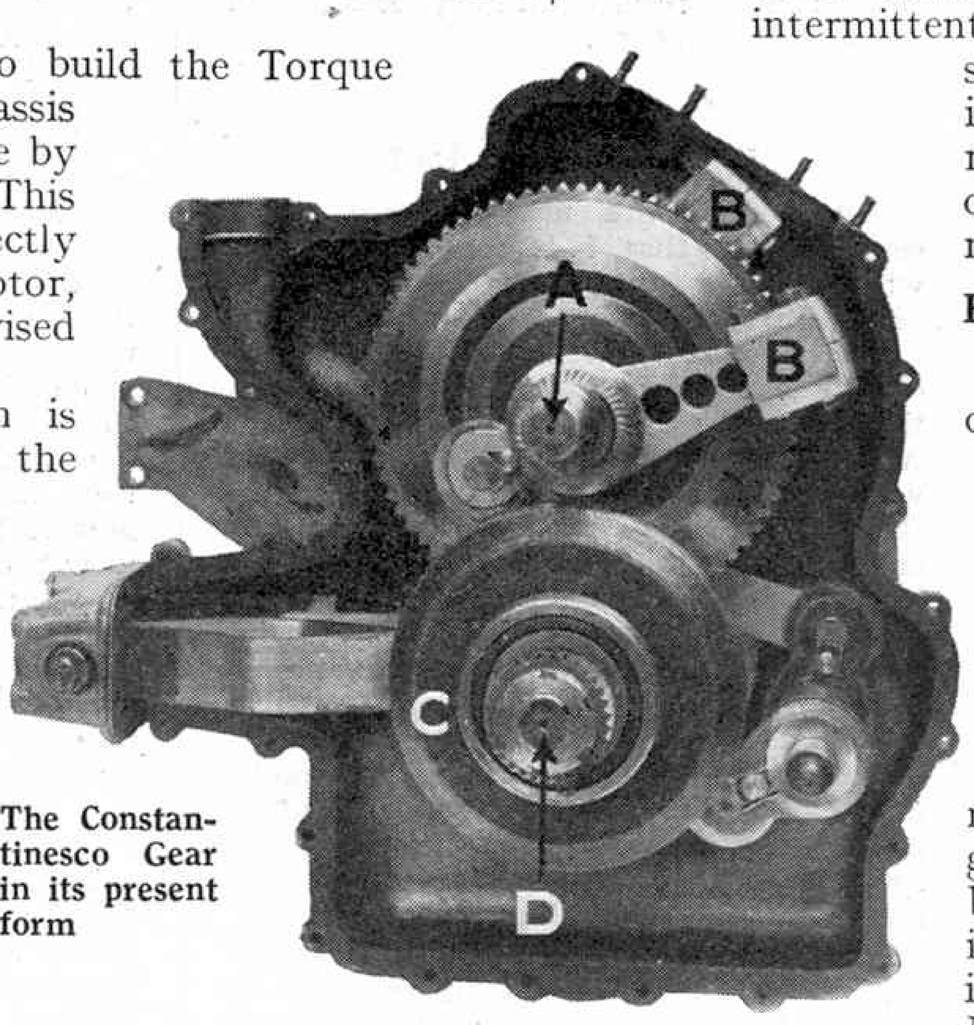


IN the first part of this article last month we gave particulars showing how a Meccano model may be built of the interesting Constantinesco Torque Converter. The model described is quite suitable for fitting to the Meccano Chassis, and if so fitted will give some surprising results.

Those who do not wish to build the Torque Converter for fitting to the chassis may demonstrate the principle by a somewhat simpler model. This model may be mounted directly on to the Meccano Electric Motor, or mounted in an improvised framework of Meccano.

This second model, which is illustrated in Figs. 8 and 9 on the next page, is shown also in the Manual of Standard Mechanisms (No. 254). In this model the lever B (Fig. 5, shown last month) is represented by a short Strip 7 (Fig. 8) bolted to the Eccentric 9. The latter is mounted on the driving shaft 10 and imparts the oscillatory movement to the lever 7.

A 1″ Gear Wheel 8 represents the weight C. Two 4½″ Strips 5 are pivoted by bolt and lock-nuts 6 to the lever 7, their other ends being connected to short Rods mounted in Couplings 11 and carrying the Pawls 3. The Couplings 11 are secured by 1″ Rods to further Couplings which are free to move about the Rod 1.



The Constantinesco Gear in its present form

The Pawls are opposed to one another, and engage a Ratchet Wheel 2 mounted on the driven shaft 1; portions of Spring Cord 4 exert a slight pressure on the Pawls, to ensure their proper engagement with the Ratchet Wheel.

Each Pawl engages with the Ratchet Wheel intermittently, one rotating it during the forward stroke of the lever 5, while the other is brought into operation on the reverse stroke. The combined effort of both produces a constant rotary motion in the shaft 1.

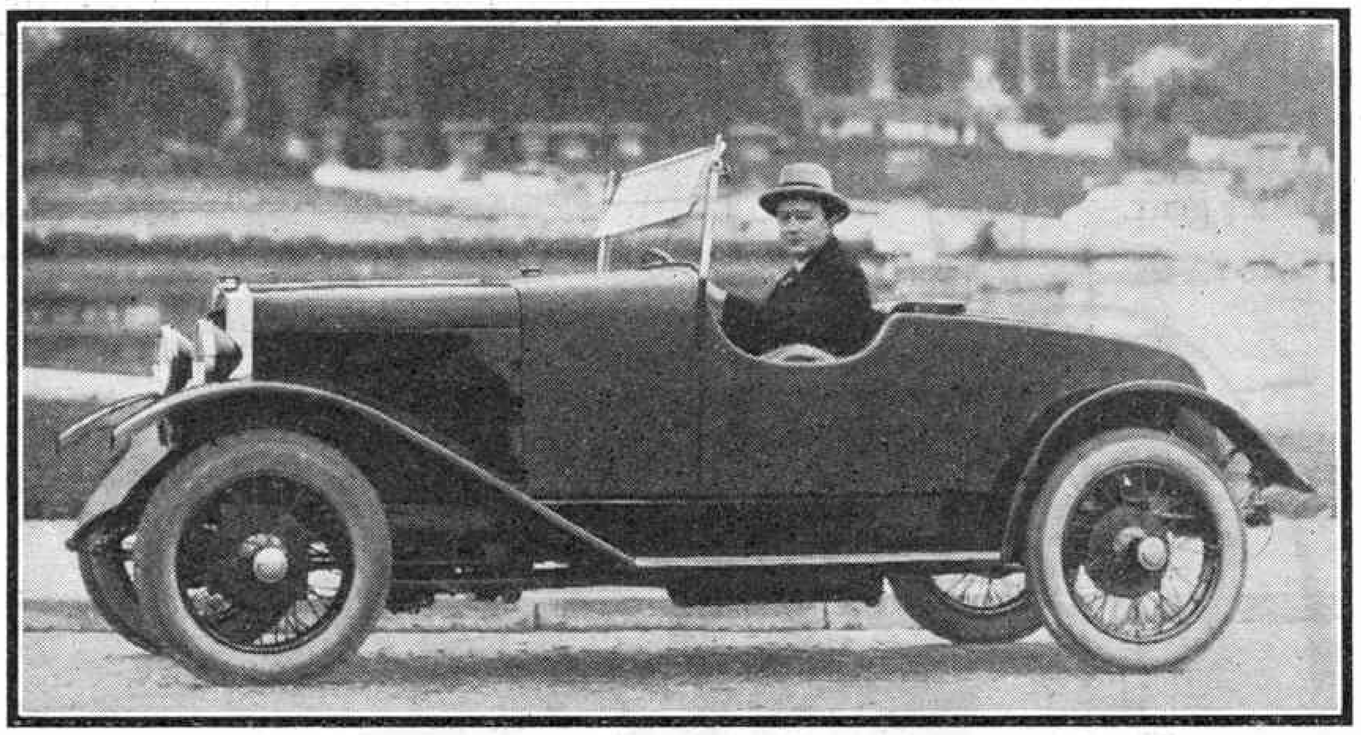
Remarkable Increase in Torque

At the time our experiments were carried out we were amazed at the remarkable increase in power that was demonstrated even by so small a form of the Converter as in the Meccano model. With the rear axle of the Meccano Chassis jacked up to allow the driving wheels to freely rotate, it was found impossible to prevent the revolution of the driving shaft when gripped with the finger and thumb below the universal joint. When it is remembered that the driving force is obtained only from a small Electric Motor, driven by a 4-volt accumulator, the remarkable torque imparted by the Converter is at once apparent.

By gripping the shaft with greater or less degree of pressure, the Converter in the model is made to demonstrate its automatic adjustment to a varying load or resistance in a remarkably effective manner. Indeed,

this automatic adjustment of the gear to the load and to the gradient is one of the most interesting features of this Meccano model—as it is one of the most important in the Converter itself—and to watch it operate is a fascination that will delight everyone interested in engineering.

The turning movement delivered to the back axle is in the nature of a number of impulses given by the Pawls to the Gear Wheels. In the Meccano models the Pawls make these impulses over a range of from about twelve teeth of the gear wheels (on what is equivalent to top gear) to one or two teeth, when great power is required to overcome considerable resistance. No teeth at all are engaged when the resistance is greater than the engine power, and this fact allows the engine to continue to revolve without declutching—indeed there is no necessity to have a clutch fitted, and no clutch is fitted to the Constantinesco car.



A Constantinesco two-seater on the road, with Mr. Constantinesco at the wheel

Practical Applications

To come now to the practical application of the Converter to the road. Some time ago a 10 h.p. engine was fitted to a large chassis, and it was demonstrated that this car, fitted with the Converter, would do many things that a car of similar horse-power, fitted with the ordinary gear-box, could not do.

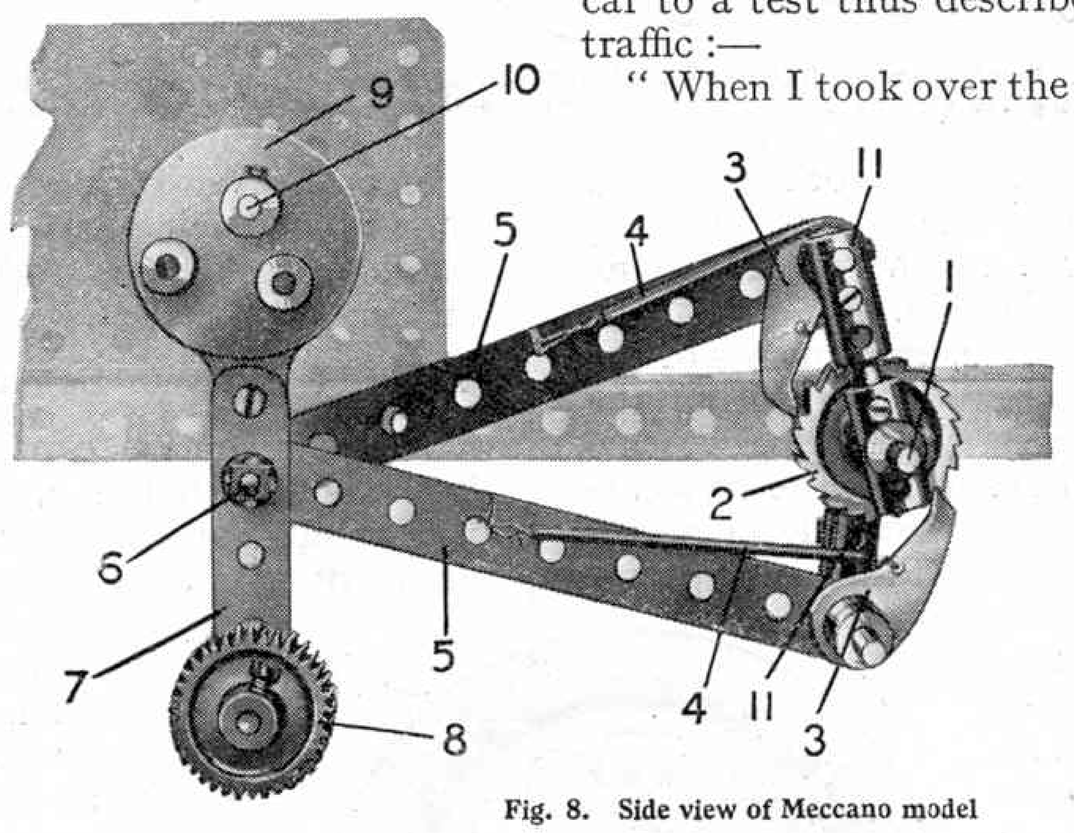


Fig. 8. Side view of Meccano model

Some of Mr. Constantinesco's friends had told him that his invention, although very interesting in theory, would not work in practice. He therefore built an experimental model—one that had been built for bench tests only—into an old 45 h.p. Sheffield-Simplex chassis. Instead of using the big engine, a 10 h.p. Singer engine was substituted. The car went splendidly and was driven about the outskirts of London with a load of ten men ! This feat was illustrated on page 350 in our issue last month. Later the same car towed a lorry up a steep incline and when 6 in. wooden blocks were placed in front of the wheels and the engine started, the car climbed smoothly over the blocks without hesitation—to the great astonishment of the people who happened to be present !

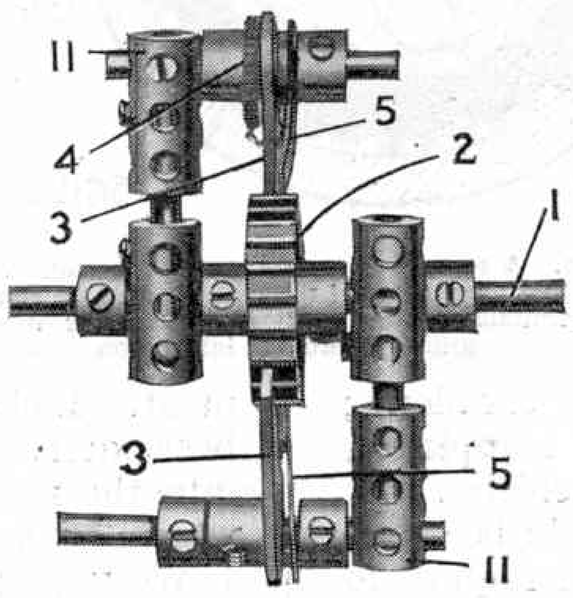


Fig. 9. End view of same model

The Constantinesco Car

Since that time many improvements in the details of the Converter have been made, and the car exhibited at the Paris Salon embodied all these improvements.

The Constantinesco car consists of a chassis fitted with a 500 c.c. two-stroke engine, built in unit with a Torque Converter. From this, a propeller shaft extends to a simple back axle with a 1 to 1 final drive.

As the Converter replaces the ordinary clutch and gear-box, the controls are of the simplest possible character. The car is controlled, indeed, entirely by the throttle, and the usual clutch pedal and gear lever are absent. Instead there is an accelerator, a brake, and a lever with three possible positions—forward, neutral and reverse. In the ordinary way this lever is placed in the forward position and the car is controlled entirely by the accelerator and the brakes.

A motorist who recently subjected the Constantinesco car to a test thus describes a trial run in heavy London traffic :—

" When I took over the car the engine was ticking over and the car was stationary, although the lever was in the forward position. Even though there is no clutch, it is a feature of the Converter that no power is transmitted to the road-wheels when the engine is running light.

" First of all, the throttle was opened wide and the engine revolutions increased to about 1,200 r.p.m. in the space of about a second. As soon as this high engine speed was reached, the Converter commenced to operate, and the car got under way in a perfectly smooth manner. Then followed the unusual experience of acceleration in a car requiring no gear changing, for the Converter is automatic in action and provides an infinite range of speed ratios. The ratio between the engine and the back axle adjusts itself automatically and without any abrupt alterations in speed.

" From the driver's point of view the most curious feature, perhaps, is that as the car's speed increases the engine speed gets less. Acceleration occurs to the sound of an engine that is slowing-down instead of, as is usually the case, being accompanied by a noise of the rising pitch of the engine revolutions. This is explained, of course, by the fact that the gear ratio gets higher and higher as the car speed increases. Finally, it reaches a limit when the maximum rate of travel of which the vehicle is capable is attained. In the car tested, fitted with a 500 c.c. engine and with the driver and passenger up, this speed is just under 40 m.p.h."

In the Meccano models mentioned above, the

transmission of the power to the main driving shaft is effected by two pawls engaging on a toothed wheel. In the actual Converter, however, the power is transmitted by devices that Mr. Constantinesco calls "Mechanic Valves."

Although these valves act on the driving shaft both on the forward and on the reverse strokes, their action is quite different from that of a pawl and ratchet gear. Their purpose is to convert the alternating nature of the received impulses into intermittent impulses of the same direction, which impulses act on the resistance shaft in a cumulative manner. One valve rotates the resistance shaft on the forward stroke, and the other valve rotates the shaft in the same direction on the reverse stroke.

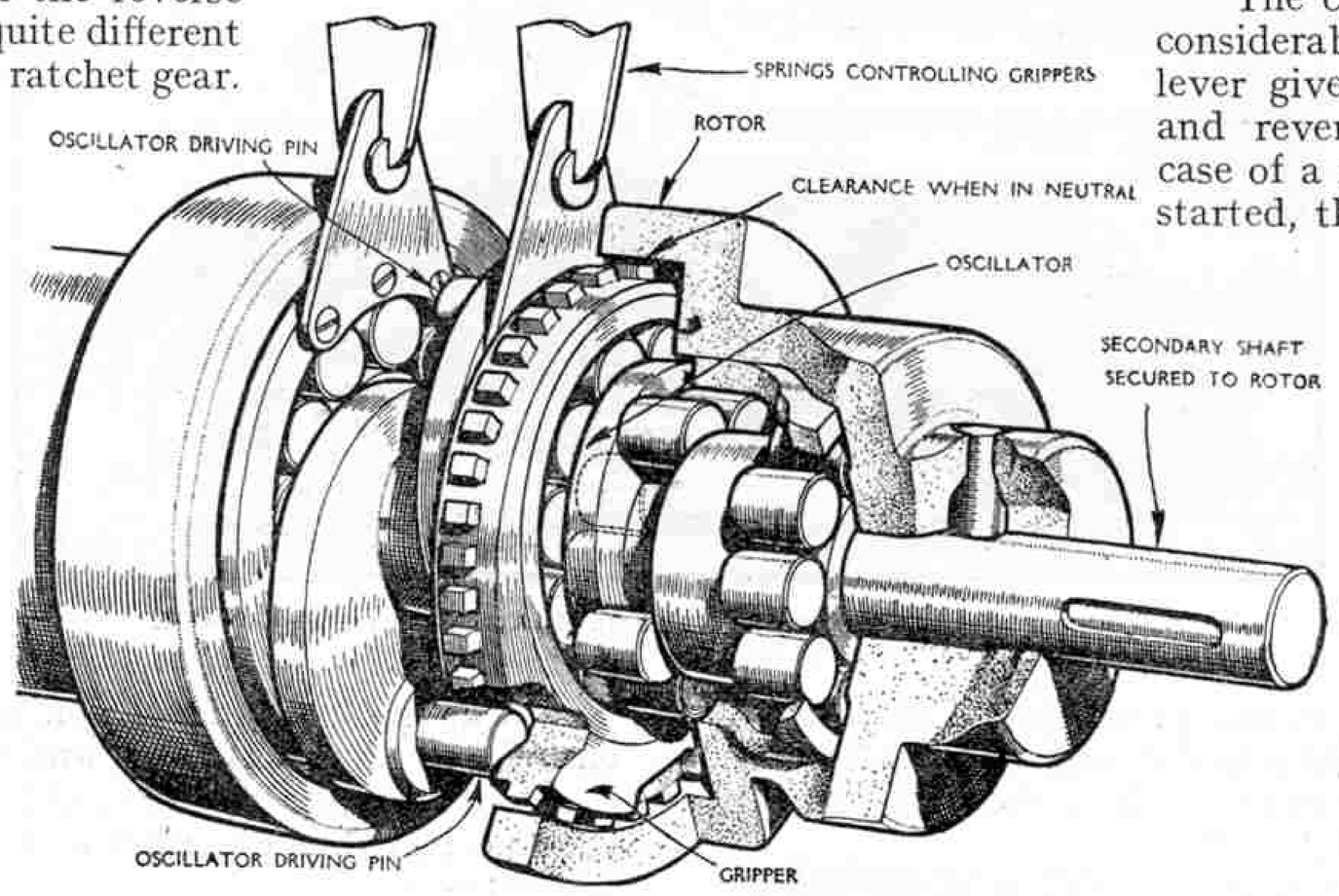


Fig. 10. One of the methods in which a pair of "mechanic valves" can be mounted. The springs controlling the grippers are actuated by a "forward-neutral-reverse" lever in the case of a car

These mechanic valves, which are the subject of separate patents, consist of an oscillator, a series of rollers, a gripper and a rotor. The oscillator is eccentric in shape and is the part driven by the lower connecting rod, whilst the rotor is secured to the shaft driving the propeller shaft and back axle (Fig. 10).

As long as the parts remain free, movements of the oscillator simply cause the gripper to run within the rotor without conveying any drive, there being a clearance space between the two. If, however, the crescent-shaped gripper is moved slightly to one side (a movement that occurs when the forward-neutral-reverse lever is moved), movements of the oscillator in one direction are conveyed to the rotor by a wedging action. In the opposite direction no drive is transmitted. If the gripper is shifted to the opposite side of the neutral position the movement of the rotor is reversed (Fig. 11).

An Invention that will Revolutionise Transport

The Torque Converter has many advantages, including the fact that when it is adapted vehicles will require engines of only about half the size of the engines used to-day.

"I believe that my invention will revolutionise all forms of transport," Mr. Constantinesco told the writer. "It is not confined to the motor car alone; it may also be applied to locomotives, aeroplanes, ploughs, tractors, tanks and all similar vehicles. At least a quarter of the cost of these vehicles will be saved by using the Converter. Their engines will require to be only about half the size of engines used to-day, so that petrol and oil consumption will be considerably lower.

"By using an engine with one or two cylinders—such as a two-cycle engine of low cost—the four, six or eight-cylindered engine is abolished and all the complicated mechanism in the working of such an engine eliminated. What is more important, the invention does away with the costly material and machinery entailed in the manufacture of multi-cylindered four-cycle engines, expensive gears and clutches.

"The control of all vehicles is considerably simplified. A simple lever gives the forward, neutral and reverse positions. In the case of a motor car the engine is started, the throttle opened, and the car immediately glides forward. Increased speed is obtained simply by opening the throttle and there is no trouble with gears or clutches.

"In actual practice the Converter is built into the engine-casing and for an average small four-seater car it fits comfortably into a box of about one cubic foot dimension. No matter what type of engine is used, its drive is converted into a smooth even-turning movement, without jerk, even though the engine may be racing. The engine may be placed either horizontally or vertically, and may be air or water-cooled."

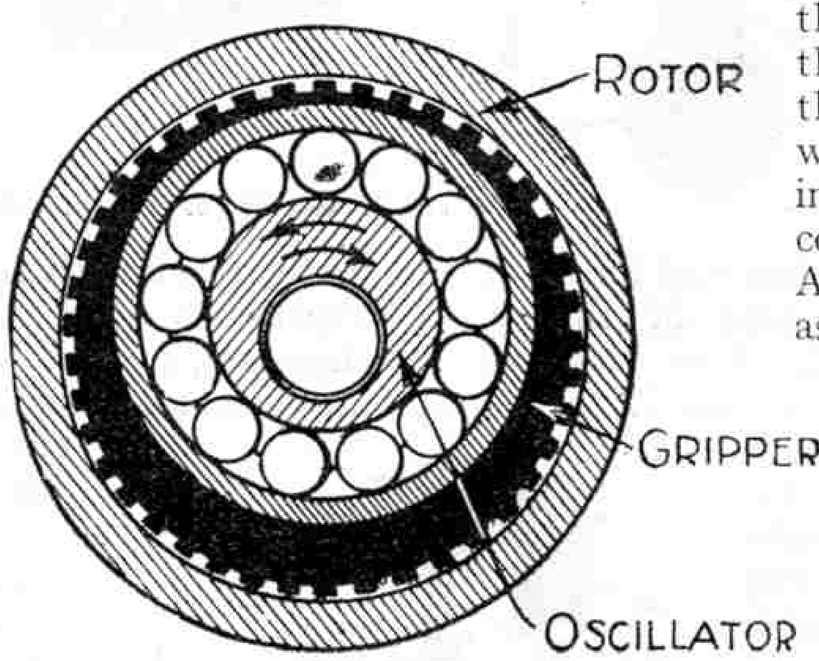


Fig. 11. A section of one form of "mechanic valve." Oscillating movements of the central shaft are converted into continuous rotary motion at the rotor when the gripper is brought into action

Value of Meccano Demonstrations

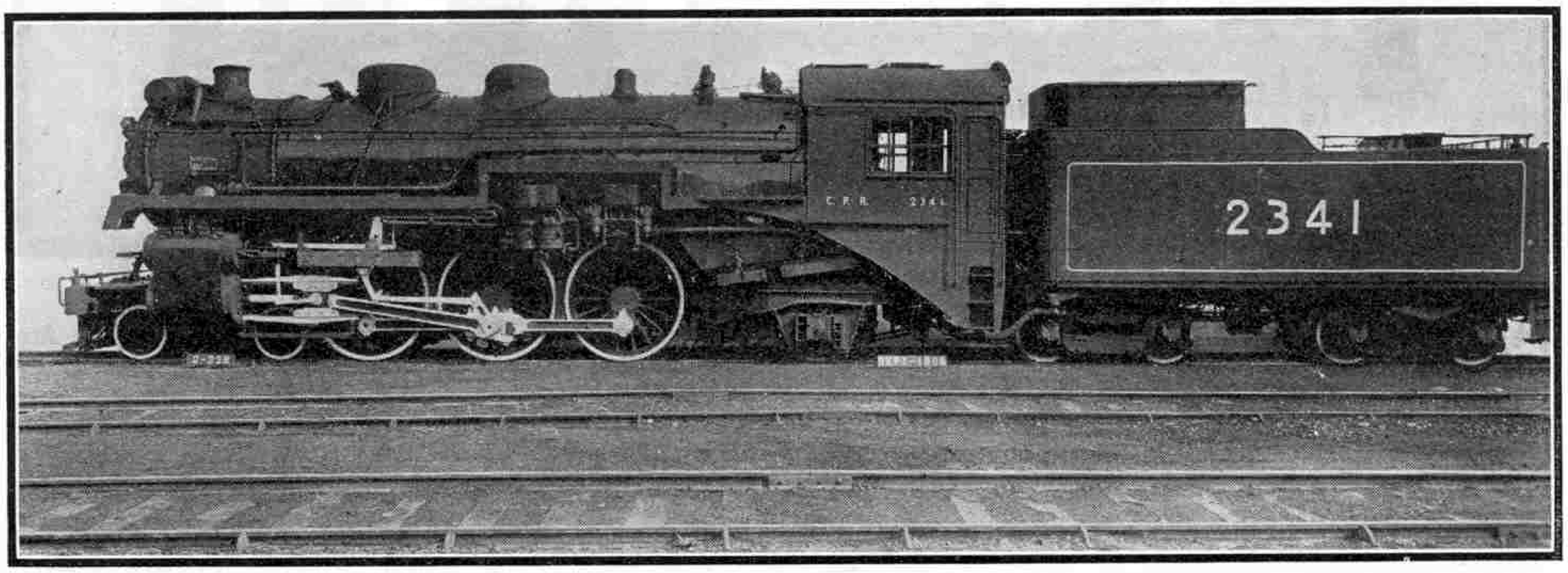
If the invention can be marketed successfully there is no doubt that a great increase in motor car sales will result, for the Converter will not only make the art of driving almost fool-proof, but it will also reduce the prices of the lighter cars to within the scope of a much larger section of the community. Our readers will do well, therefore, to equip themselves in advance with practical information concerning this wonderful apparatus. As previously indicated, they will learn as much from the construction of a Meccano model of the Converter as they could from a lengthy study of any amount of drawings, plans and technical description.

Many readers wrote to us after the first reference to the Torque Converter appeared in the "*M.M.*" three years ago and remarked upon the thrills to be obtained from building a model of an entirely new mechanical movement. Incidentally, much satisfaction appears to have been derived from the subsequent initiation of Dad into the mysteries of a piece of mechanism concerning which he had hitherto been entirely ignorant!

We hope that new interest in the subject will now be aroused and that readers will experiment with the possibilities of the Torque Converter as applied to Meccano models. We shall be very pleased to receive particulars of such experiments and if they are of sufficient general interest, to deal with them in the pages of the "*M.M.*"

New "Pacific" Type Locomotives

For Canadian Pacific Railway



A SHORT time ago the Canadian Pacific Railway ordered twenty-four new "Pacific" type locomotives from the Montreal Locomotive Works. Several of these locos, which are being constructed to drawings and specifications prepared by the Canadian Pacific, have now been delivered.

The locomotives are known as the G-3-d class and are similar in general design to the well-known 2300 series "Pacific" type locomotives already in service, but with some extensive improvements over those previously built, with the object of increasing speed, haulage capacity and general efficiency.

The most important feature is the increase in boiler pressure to 250 lbs. per square inch from 200 lbs. per square inch, and this has been accomplished without any material increase in the weight of the locomotive by using a stronger nickel-steel boiler plate. This is the first nickel-steel boiler shell plate used in locomotive boiler construction on the American continent.

Superheaters have been applied with a combined header and throttle that permits the use of superheated steam for the auxiliary equipment—such as air compressors, feed water pumps—headlight turbine and whistle and feed water heaters also have been applied.

High Standard of Equipment

In the re-designing of these locomotives, for the application of extra equipment and the improvement of details in general, the fine appearance of the 2300 series, as a whole, has been maintained, if not improved upon, in keeping with the high standard of Canadian Pacific equipment generally.

The accompanying illustration shows one of the recently delivered locos and leading particulars of this type are given in the accompanying panel. The track gauge is 4 ft. 8½ in. and the tender is of the eight-wheeled type, with a capacity of 8,000 gallons of water and twelve tons of fuel. The engine is designed for burning what is known as "soft" coal.

It is interesting to note that delivery has also commenced of new "Mikado" type locomotives, of which twenty are on order. These locomotives are of the 5300 class and are being built by the Canadian Locomotive Company at Kingston, Ontario. Their design is generally the same as the 5300 class engines already in use, but improvements have been added similar to those applied to the 2300 series.

Leading Dimensions of G-3-d Class Canadian Pacific Locomotives

CYLINDERS :—	
Diameter	23 in.
Stroke	30 in.
Driving Wheel Diameter	75 in.
BOILER :—	
Maximum diameter O.S.	88 in.
Working pressure	250 lbs.
FUEL BOX :—	
Length	111 in.
Width	84½ in.
TUBES :—	
28 2 in. 160 2¼ in. 40 5½ in.	
Length of all Tubes	18 ft.
WHEEL BASE :—	
Driving	13 ft. 2 in.
Engine	35 ft. 0 in.
Engine and Tender	67 ft. 10 in.
WEIGHT IN WORKING ORDER :—	
Leading	62,500 lbs.
Driving	184,000 lbs.
Trailing	60,000 lbs.
Engine	306,500 lbs.
Tender	191,000 lbs.
HEATING SURFACE :—	
Tubes	1,950 sq. ft.
Flues	1,031 sq. ft.
Fire Box	258 sq. ft.
Arch Tubes	33 sq. ft.
Superheater	864 sq. ft.
Grate Area	65 sq. ft.
Maximum Tractive Effort	45,000
Factor of Adhesion	4.08

The "Mikado" type locomotives have in addition, however, mechanical stokers. The tender is of the eight-wheeled type, but of larger capacity than the "Pacific" tender already mentioned. It is able to accommodate 10,000 gallons of water and 16 tons of fuel.

The Canadian Pacific Railway has a famous train, known as the "Trans-Canada Limited," which runs from Montreal to Vancouver via Toronto. It is the longest distance all-sleeper train in the American continent, and offers a through unbroken service between the Atlantic and the Pacific without a change of cars. In either direction it saves a day in crossing Canada and is much used by travellers and by business men.

A Famous Canadian Train

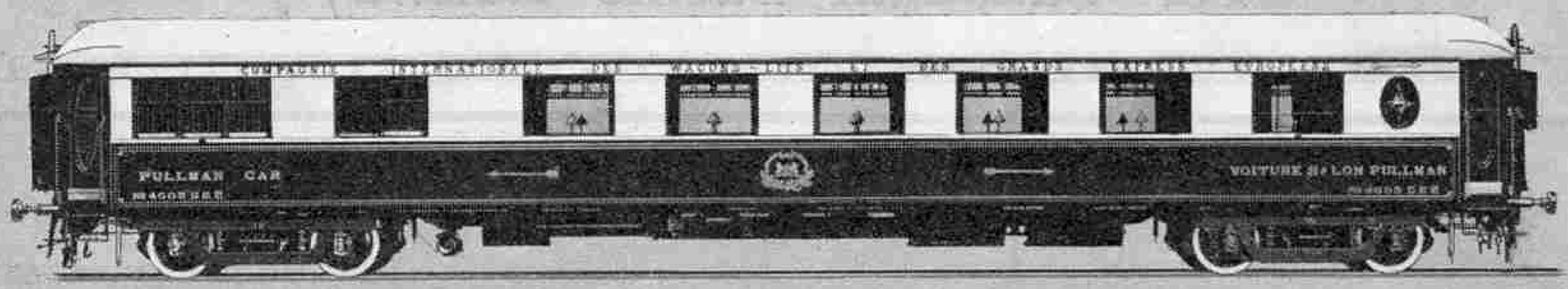
The journey from Montreal to Vancouver occupies 89 hours 15 minutes, but the eastward journey from Vancouver to Montreal is done in 88 hours 30 minutes.

The "Trans-Canada Limited" is an all-steel train of the most modern construction, carries sleeping car passengers only and consists of dining and sleeping compartments and special observation cars, all of which are finished in the most luxurious manner. An interesting novelty is the introduction of an open top observation car, which is attached between Calgary and Revelstoke, and from which an unobstructed view of the scenery of the Rockies is obtained. As the train is hauled by oil-burning engines in the mountains, no inconvenience to passengers is caused by smoke or cinders.

In the Rocky Mountains is some of the most magnificent mountain scenery in the world. There are nearly 700 peaks that are over 6,000 ft. in height; numerous beautiful mountain lakes, swift rivers, forests, glaciers, and extensive reservations, and many other attractions to delight the tourist. The region is a famous holiday centre for the enjoyment of climbing, fishing, motoring and hunting, and special accommodation for holiday-makers is arranged at four hotels and nine bungalow-camps, all of which are organised by the Canadian Pacific.

Incidentally, it may be mentioned that the Canadian Pacific Railway has over 20,000 miles of track in Canada and in the United States and also owns Steamship services across the Atlantic and Pacific, and twelve magnificent hotels. In addition, the railway operates the whole of its own sleeping-car, dining-car, telegraph and express services.

Famous Trains and the Routes over which they run



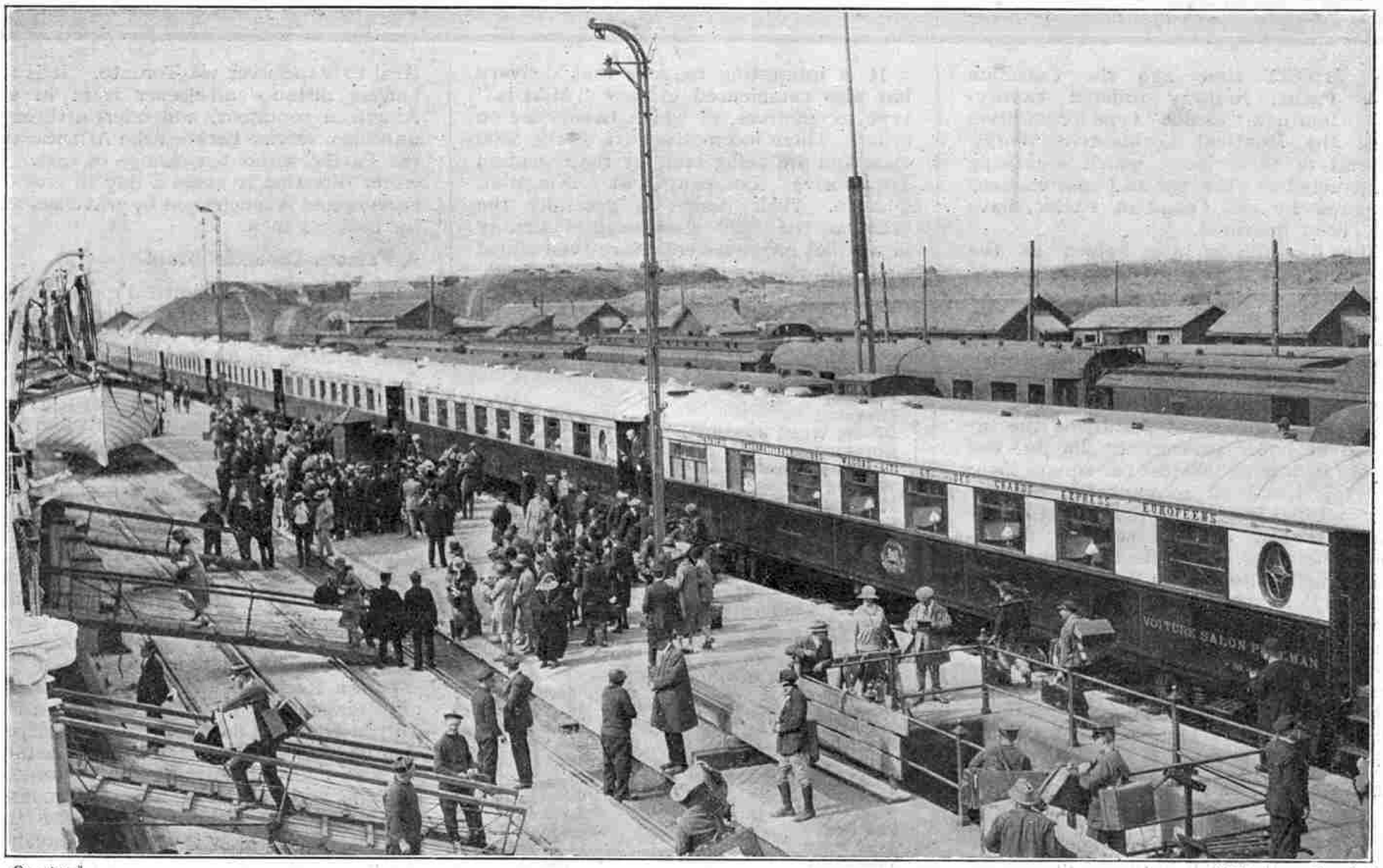
by CECIL. J. ALLEN. M.Inst. T. Etc.

V.—THE "GOLDEN ARROW," CHEMIN DE FER DU NORD OF FRANCE

IT is a sure sign of growing public interest in railways that not only is the habit of naming express locomotives once again on the increase, but there is an outbreak of giving names to the "crack" express trains as well. And why not? Every "*Meccano Magazine*" reader will, I know, agree with me that it is much more exciting to look forward to a trip on the "*Flying Scotsman*" than a mere journey on the "10 a.m. from King's Cross," and there is no doubt that the choice of a suitable nickname for a present-day flier, in these days of speed, is a powerful advertisement in its favour.

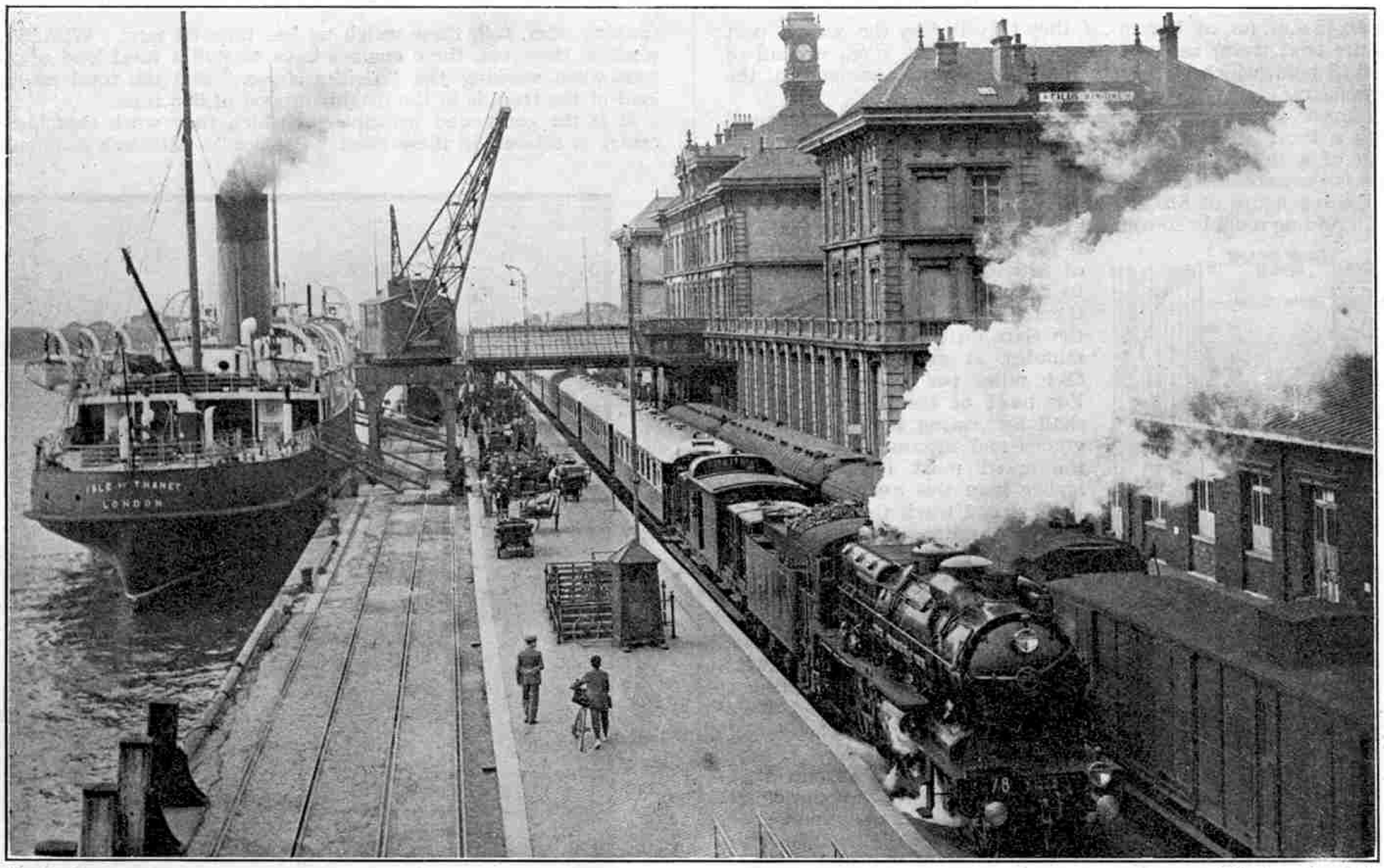
The train that we are reading about this month is barely a year old, but it is already world-famous. It would hardly have been possible for its owners to have hit upon a title more thrilling, and at the same time more appropriate, than the "*Golden Arrow.*" So far as concerns its "arrow" character, it is the fastest train in the world, for the distance covered—even on our own Great Western Railway no regular train is booked at 58.1 miles per hour average speed over a journey as long as 184 miles—and the "gold" is well exemplified in the magnificent Pullman cars that exclusively make up its passenger equipment.

If, regretfully, we have to concede to our French friends the palm in the matter of speed, and, as we shall see presently, in the locomotive work entailed by the haulage of a train of this tremendous weight over the grades between Calais and Paris at such a rate, we can at least comfort ourselves with the reflection that, when our neighbours want to purchase the most comfortable



Courtesy] ["*Railway Gazette*"

Boarding the "*Golden Arrow*" at Calais



Courtesy] ["Railway Gazette"

Right Away! The "*Golden Arrow*" leaving the Gare Maritime, Calais

coaches that money can buy they have to come to England for them. For you will find on each one of the magnificent Pullmans that make up the "*Golden Arrow*," as you will on the sleeping and dining cars of the equally famous "*Blue Train*," the name-plate of a British manufacturer.

Long before we have actually moored at the Quay at Calais we shall have "spotted" the long train of cars, in the familiar Pullman livery of umber and cream, standing on the quayside awaiting its passengers. Lest we should make any mistake, we shall find painted on the side of each coach two real golden arrows. In addition to this, each car carries its title in English and French—"*Pullman Car*" and "*Voiture Salon Pullman*" respectively—as well as the imposing name of the owning company, which takes up the whole of the space above the windows—"*Compagnie Internationale des Wagons-Lits et des Grands Express Europeens.*" We call it the "*International Sleeping Car Company*," for short.

Ten Pullmans make up the total passenger accommodation of the "*Golden Arrow.*" As you will see in the photographs reproduced, they are longer than our English cars, and the interior view will show you that they are wider, too. Each coach is 77 ft. in length over buffers and 9 ft. 7 in. in extreme width. The Pullmans are assembled in pairs, each pair seating 60 passengers, and having its own kitchen, so that passengers can be served with meals exactly where they sit, instead of having to walk through the train to a dining car. Altogether, therefore, 30 first-class passengers can be carried, in the most luxurious fashion possible, the extra charge demanded, over first-class fare, being the very reasonable one of about 13s. 6d.

Leading Dimensions of "Super-Pacific" (4-6-2) Four-Cylinder Compound Express Locomotives.

Chemin de Fer du Nord of France. Series 3.1201—3.1240.

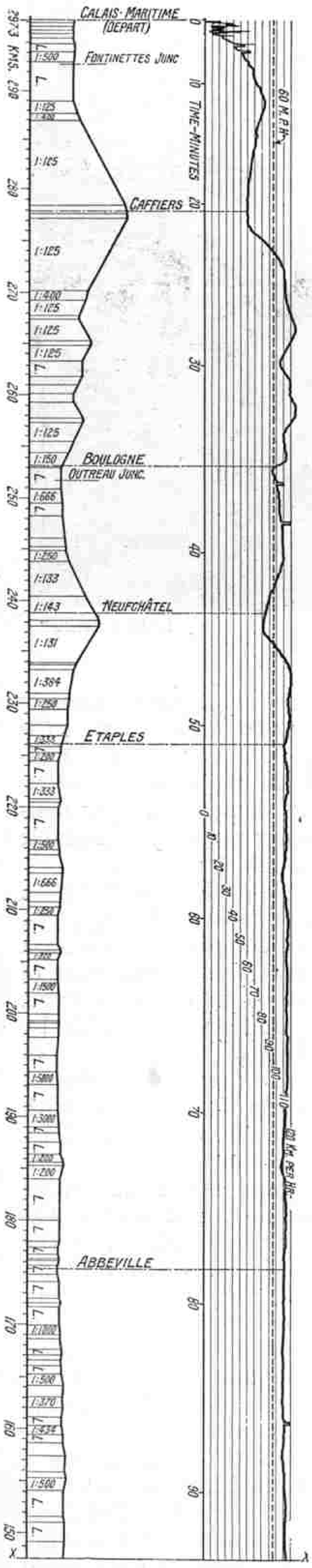
High Pressure Cylinders, Diameter	...17¾ in.
" " " Stroke ...	...26 "
Low " " Diameter	...24½ "
" " " Stroke ...	...27½ "
Driving Wheels, Diameter ...	6 ft. 3 in.
Heating Surface, Tubes and Flues	2,422 sq. ft.
" " Firebox	219 "
" " Superheater ...	616 "
" " Total	3,257 "
Firegrate Area	37½ "
Working Pressure	227 lb. per sq. in.
Tractive Effort (at 85 per cent. wkg. press.)	38,700 lb.
Water Capacity of Tender ...	... 6,930 gallons
Coal " "	7 tons
Adhesion Weight of Engine ...	55 "
Total Weight of Engine (in working order)	95 "
Weight of Engine and Tender (full)	159 "

The only other vehicle in the train is the peculiar-looking luggage-brake, seen in the photographs next to the engine. The middle part of this is a van of an ordinary type, but it is flanked on either side by detachable luggage boxes, or containers. These have been loaded at Victoria Station in London with the passengers' luggage, lifted by powerful cranes off the Southern Railway luggage truck at Dover on to the steamer, and then transferred by crane at Calais on to the two ends of this combined van and luggage truck, for the journey to Paris. You can well imagine how much time and trouble are thus saved at Dover and Calais, seeing that the staff have not to handle each article of luggage separately.

Another privilege that is accorded to "*Golden Arrow*" passengers, in exchange for their extra fare, is that they do not have to pass through the "customs," but have their hand luggage examined on the train after leaving Calais. This enables the "*Golden Arrow*" to get away very quickly after the arrival of the boat. In fact, with this quicker start, passengers having left Victoria

at 10.45 a.m. (or at 11 a.m., if they travelled by the second part of the boat train) can now reach Paris at 5.40 p.m., instead of at 6.15 p.m., which is the time of arrival of the remainder of the passengers.

Eleven vehicles, therefore, make up the "*Golden Arrow*," with a total length, including engine and tender, of about one-fifth of a mile. To our English standards, the weight of the cars is very considerable. The total "tare" of the train, in fact, is the big figure of 510,980 kilogrammes, or exactly 500 tons in all. Adding roughly 20 tons for passengers, and 5 tons for luggage, if the train is full, we have a total of 525 tons. The engine has got to run this enormous weight over the 184.1 miles between Calais and the Gare du Nord at Paris in 190 minutes, at an average speed of 58.1 miles per hour throughout. For most of the distance, as we shall see, owing to certain heavy grades and intermediate slowings, the speed must be considerably higher than this average figure.



These diagrams are reproduced by permission of the "Railway Magazine." They are taken directly from the speed indicating apparatus of the engine

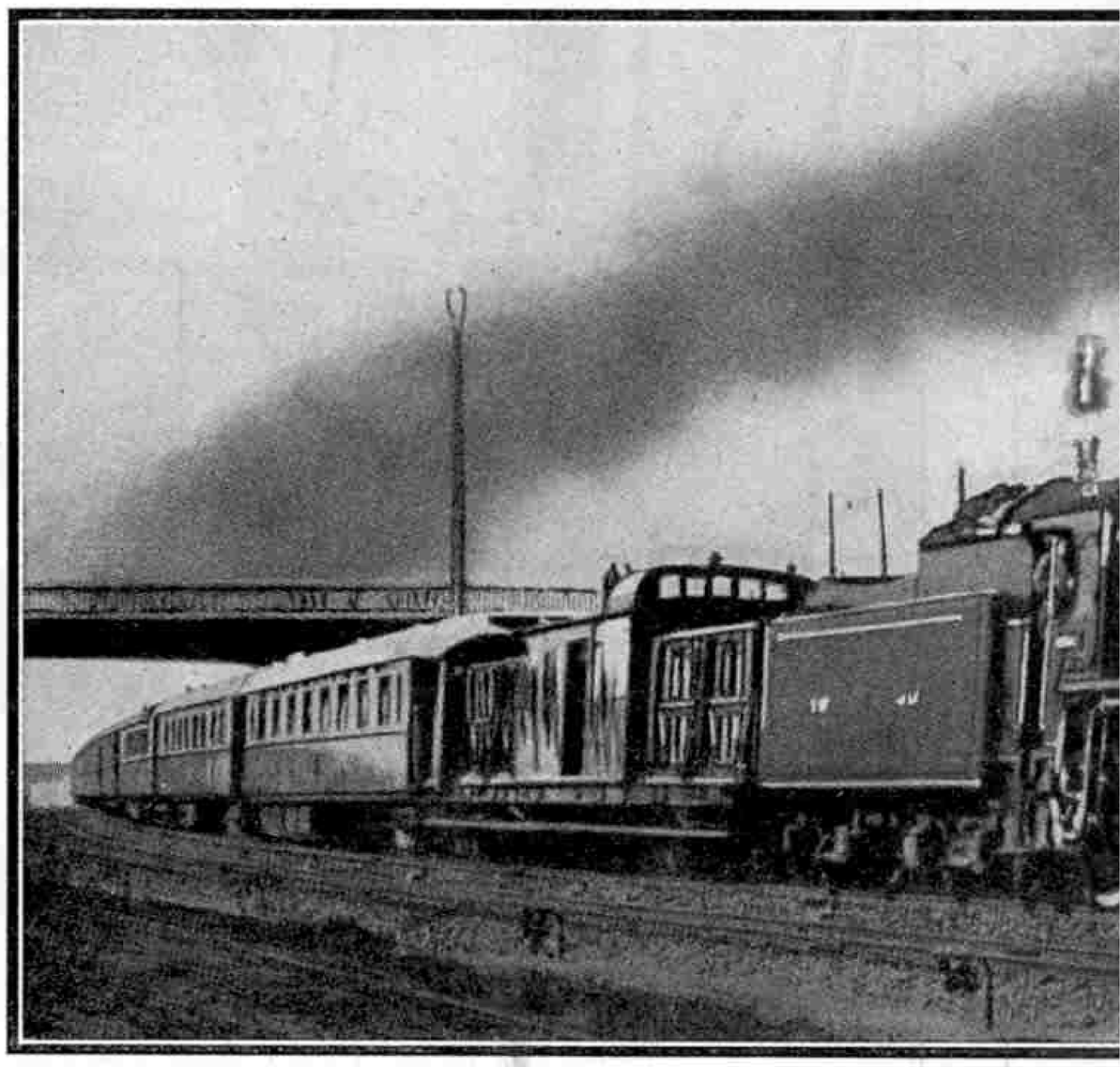
If we can teach the French how to build railway coaches, let it be said at once that they need to learn little from us in the matter of locomotive construction. We shall find one of the latest "Super-Pacifics" of the Chemin de Fer du Nord at the head of the train, numbered somewhere between 3.1201 and 3.1240. Although they are not as heavy as the 4–6–2 engines of certain other French lines, it is tolerably certain that no other French railway can equal the Nord in the performance of its locomotives. Indeed, in proportion to their size and weight, it is questionable whether any other railway in the world could beat what these Nord "Pacifics" do day after day, not only on the "*Golden Arrow*" express, but on many other trains as well.

Between Abbeville and Paris, for example, the "*Golden Arrow*" is only allowed 108 minutes for the distance of 109 miles, start to stop, and the outward-bound 10 a.m. and 12 noon boat trains from Paris to Calais get 110 minutes in which to make the same journey, start to stop. The afternoon boat express, leaving Paris at 4 p.m. for Boulogne, is expected to run the 140½ miles to Etaples in 141 minutes. All these timings include a very severe slack, to 15 miles an hour, through Amiens.

In the north-bound direction from Paris the heavy 8.10 a.m. express, with portions for both Brussels and Berlin, is booked to pass St. Quentin, 95 miles from the start, in 93 minutes, reaching Aulnoye, 134 miles, in 136 minutes; while the 7.30 p.m. north-bound express does the same journey in a minute less. Yet again, the 119¾ miles from Paris to Arras are run by various trains in 121, 122 and 123 minutes.

And what is the size and power of the locomotives to which the heaviest of these duties are entrusted? The "Super-Pacifics," referred to in the last paragraph but two, weigh without tenders 95 English tons in working order, or 2½ tons only more than the "*Flying Scotsman*" 4–6–2 engines of the L.N.E.R. Enormous eight-wheeled tenders have to be carried, as there are no track-troughs between Calais and Paris, and in running trim, full, these weigh no less than 64 tons. With their tenders, therefore, these engines have to pull a total load of 590 tons when working the "*Golden Arrow*," and the total moving load of the train is in the neighbourhood of 685 tons.

It is the compound principle on which they work that is the centre of interest in these Nord "Pacifics." Although compound



The "Golden Arrow" at full speed, nea

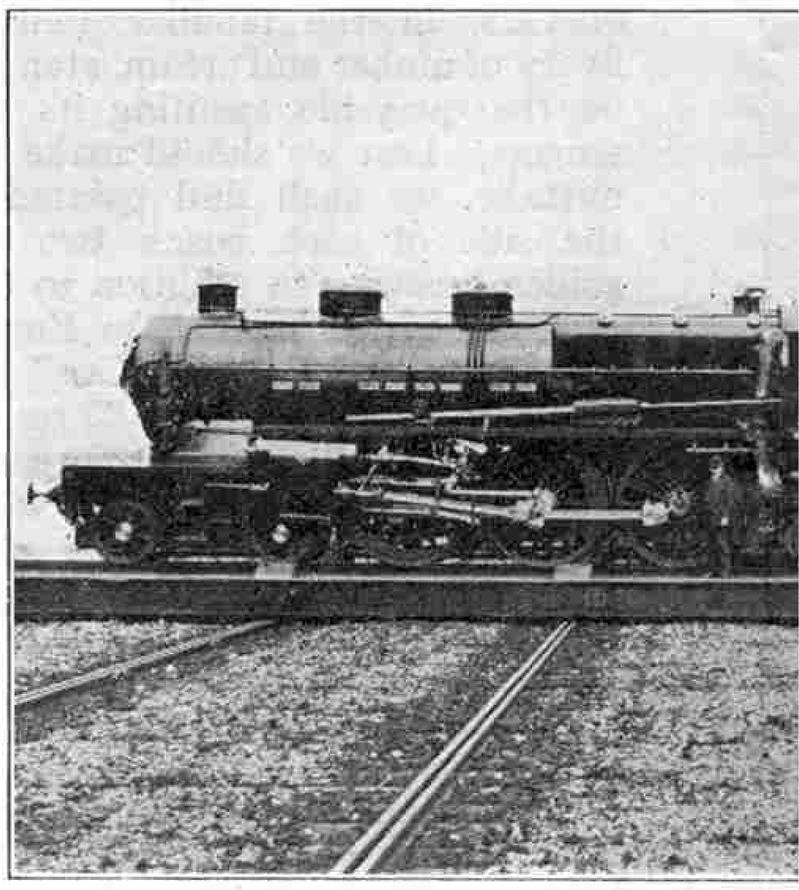
locomotive working has never taken a hold in this country, with the exception of the familiar Midland compound 4–4–0 engines of the L.M.S. Railway, it is the customary method of locomotive propulsion on the Continent of Europe.

It may be explained, for the benefit of any reader who is not quite sure what the word "compound" means, that the steam is carried direct from the boiler to one or two "high pressure" cylinders, in which it goes through a part of its expansive working; after that it is led on into two "low pressure" cylinders, where the expansion is completed.

The Nord engines are compounded on the "de Glehn" system, the two high pressure cylinders of which are seen outside the frames, while the low pressure cylinders are inside.

It needs brains to get the best work out of a compound. The training of express drivers is carried rather further in France than it is in this country, which furnishes in part, no doubt, the explanation of the extraordinary feats that the Frenchmen get out of their engines.

The design of the engines themselves provides the rest of the explanation. Each pair of cylinders has its own set of Walschaert's valve-gear, and the driver can vary the cut-off in both high and low pressure cylinders independently of each other. The knack in managing these compounds lies chiefly in working these two cut-offs in exactly the right proportion to each other—the high pressure, of course, later in the stroke than the low pressure—to make the best use of the steam generated in the short boiler.

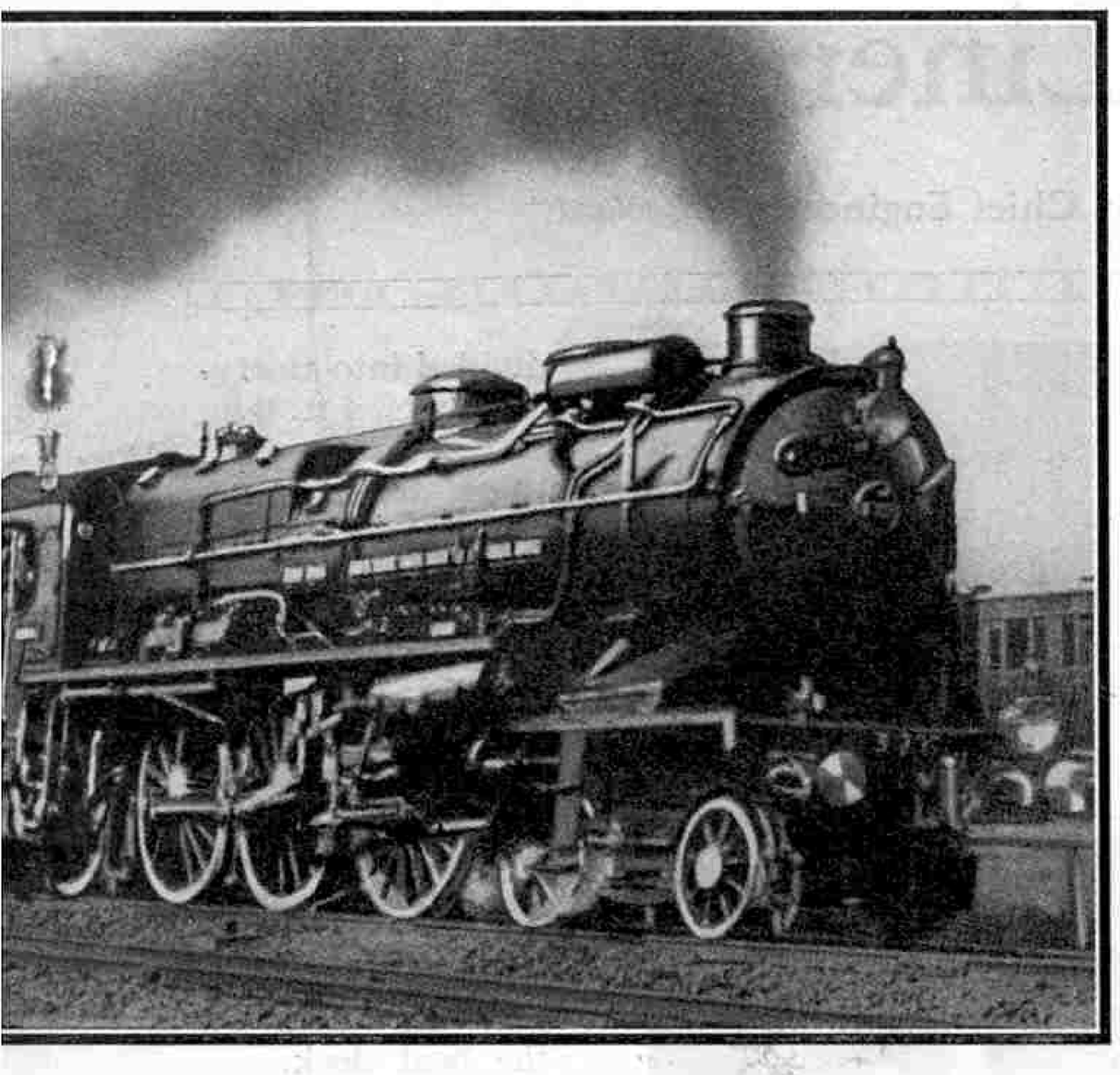


Courtesy]

4-Cylinder Compound "Super-Pacific" Loco

The fireman, too, has a strenuous task. In the first place,

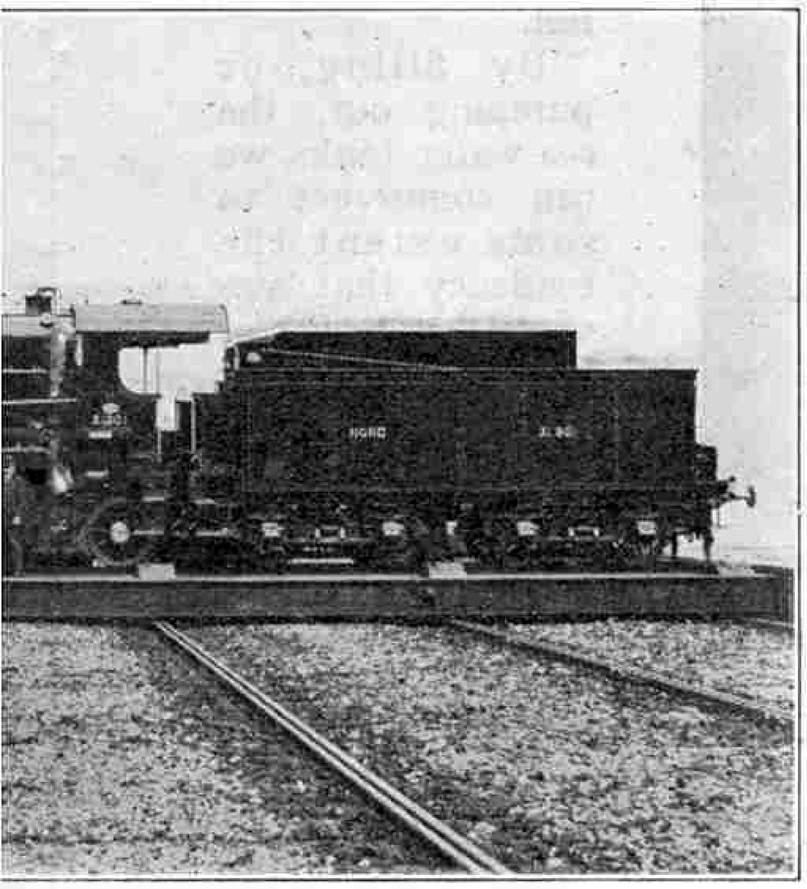
the coal burned is of poor quality as compared with that to which our engines are accustomed, and is often in the form of "briquettes," or slack coal compressed into blocks. Then the firebox is exceptionally long and narrow—11 ft. 6 in. in length by 3 ft. 3 in. in width—so that the fireman has to shoot the contents of his shovel over quite a long distance. Yet the consumption of fuel on these



ed, near Villiers-le-Bel, en route to Calais

enormously hard duties, and poor fuel at that, varies between 60 and 70 lb. a mile, or not above 10 lb. a mile more than the average of the L.N.E.R. "Pacifics," which use superior coal and, on the average, perform considerably easier duties. Economy in coal consumption in the French engines is assisted by the entirely automatic heater of the boiler feed-water, seen in the picture above on the top of the boiler behind the chimney. This, it is calculated, is responsible for saving 7 lb. of coal per mile.

But the hour of departure has now arrived and we must board the train. The time-table gives the start as "14.30," according to the twenty-four hour system prevailing abroad; in our English time it is 2.30 in the afternoon.



[*Railway Magazine*

" Locomotive, Northern Railway of France

It is a very difficult exit from Calais. From the Gare Maritime through the Town Station, for a distance of well over two miles; there are many sharp curves. Then, after a brief level run, the engine is faced, four miles after starting, with the beginning of the tremendous climb up the downland behind Cap Gris Nez, to the summit at Caffiers. For seven miles this grade is continuously at 1 in 125, corresponding almost exactly with the worst seven miles of the climb from Carlisle up to Shap, on the West Coast main line of our L.M.S. Railway.

By one of the rapid accelerations that are so common on the Nord, from the outskirts of Calais to the foot of the ascent to Caffiers we may expect to have attained anything from 50 to 55 miles an hour. Up the 1 in 125 speed will steadily fall, of course, but we shall probably top the summit at not far off 40 miles an hour. The upper stages of the climb may make it necessary for the engine to be worked in somewhere near full forward gear, in both high and low pressure cylinders, with the regulator wide open as well. If we were on the footplate we should see that the boiler was finding all the steam necessary for this tremendously hard work, the needle of the pressure gauge remaining steadily at the 227 lb. mark. In all probability the power exerted by the locomotive on this climb will closely approach the figure of 2,220 horse-power at which these "Super-Pacifics" are officially rated.

Once over Caffiers Summit we have before us a 7-mile descent at the same inclination past Marquise, and then sharp undulations at the same figure to Boulogne. In running downhill, the driver will not exceed the maximum figure of 120 kilometres (75 miles) per hour that is laid down by statute in France. Part of the equipment of his engine is a speed indicator, which not only shows him the exact speed at which he is running, throughout the journey, but takes a record of that speed on a moving roll of paper. This is another matter in which our friends on the Continent are ahead of us. The roll is not accessible to the driver, but keeps an automatic record of his journey, which makes him very careful to see that all the prescribed restrictions of speed are duly observed. His speed indicator helps him in their proper observance.

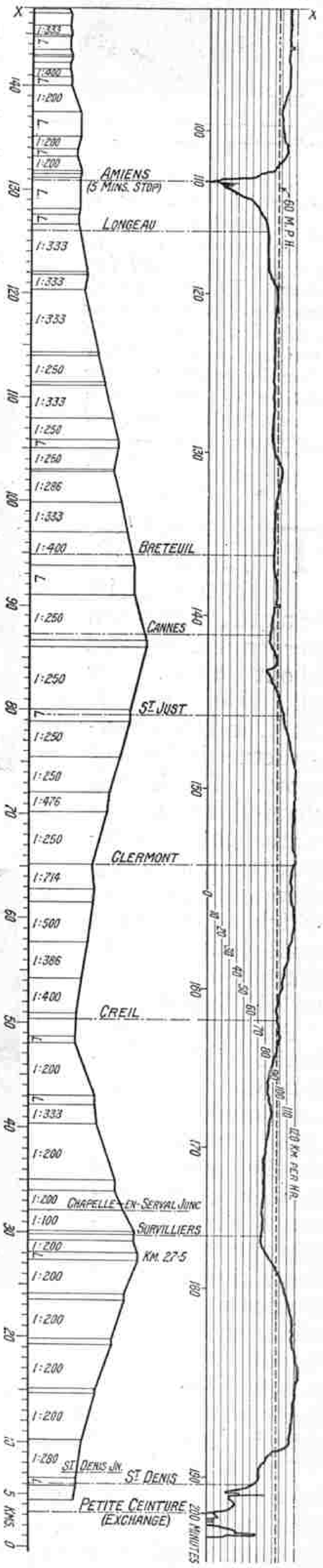
From what we have heard about the French railways, we may think even 75 miles an hour to be something more than safe. But do not let us disparage the track of the Nord. Since the war a great deal of money has been spent in putting it into first-class order, and although possibly it may not quite equal the very best in our own country, yet it is of a solid and well-laid character.

In common with almost all Continental railways, the Nord uses a flat-bottomed rail, in place of our familiar dumb-bell, or "bull-head" section; the rails weigh 92½ lb. per yard, and are 18 metres in length, which is just 6 in. shorter than the L.M.S. standard of 60 ft. Chairs are not used, of course, but flat steel "sole plates" distribute the weight of the rails to the sleepers, of which 30 are used to every rail-length. Some of the movable "tongues" of the main line switches are no less than 40 ft. in length.

We dash through the Tintilleries Station at Boulogne, 26¼ miles from Calais, threading several tunnels as we skirt the eastern suburbs of the town, and then swing round to join the line from the Gare Maritime at the junction known as the "Bifurcation d'Outreau." The speed round the curve will be rather higher, very likely, than that to which we are accustomed in England, but we need not fear that the driver is taking any undue risks, even though we do go over the junction at 50 miles an hour or so.

After 4½ miles of level running from the Outreau Junction, there comes a sharp rise of four miles to Neufchâtel, and a corresponding descent of five miles to a point near Etaples. But now the engine has an easier length ahead. For the next 56 miles, through Etaples and Abbeville and almost to Amiens, the line is practically dead

(*Continued on page* 455)



These diagrams show the actual speeds on a journey of the "Blue" Train between Calais and the Central Exchange Sidings outside Paris. The gradients of the road are also shown

Some Unfamiliar Features of a Liner

By Captain John R. Mackay, Chief Engineer, "*Belgenland*"

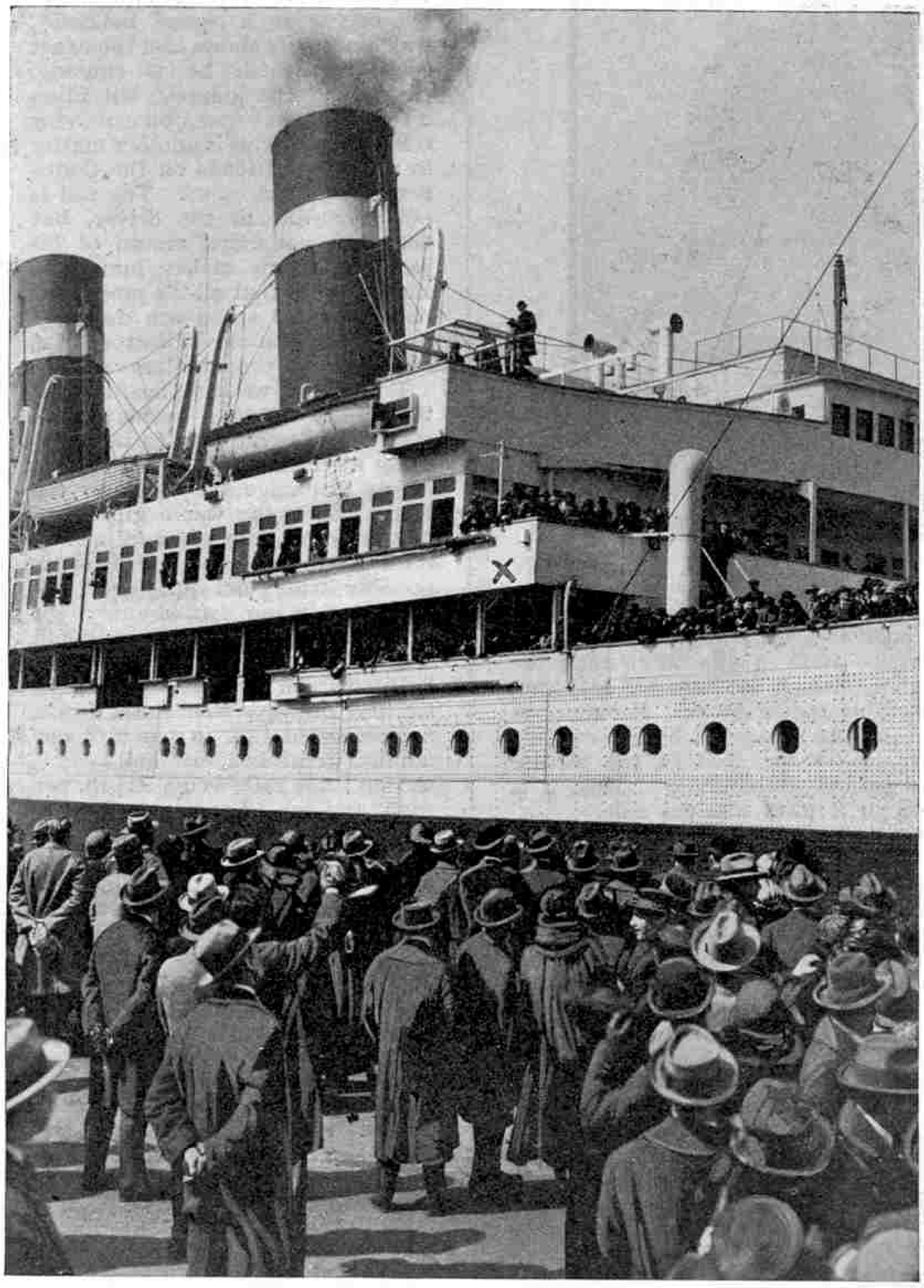
This article is the second of a series of talks broadcast from the "Belgenland" when in the Bay of Bengal last year. The first instalment was printed in our issue last month. The articles, which appear here by courtesy of the Editor of the "Ocean Ferry," will be continued in future issues.—

EDITOR.

* * *

THE "*Belgenland*" is 670 ft. in length, between perpendiculars, and about 698 ft. over all. Her beam is 78 ft. and the superstructure is five feet more. The hull is divided into twelve watertight compartments, by eleven bulkheads, which are steel walls rising from the bottom of the ship to "D" deck.

All the apertures in the bulkheads below the water-line are closed by watertight doors, those in the engine and boiler compartments being electrically operated. These doors close in a few moments when the officer on the bridge throws over a switch located there. All the water-tight doors are closed in foggy weather, and in pilot waters when there is much shipping around the ship.



This photograph, of the "Belgenland" at New York, shows a structural detail that often escapes direct observation. This is the "overhang" of the promenade deck (marked X) that gives the deck a greater breadth by 5 ft. than the deck below

The ship has a double bottom that is continuous from the forward bulkhead to the after one. This adds greatly to the strength of the vessel, and provides a measure of safety in case of grounding, or straining of the hull in heavy weather. Although the outer shell may leak, the inner bottom holds the vessel tight.

This double bottom is of cellular construction, and is divided into thirty-six tanks, 4 ft. 6 in. in depth. Some of these tanks carry the fresh water for washing and drinking. Incidentally, I may say that the drinking-water passes through three filters, and the washing water through two filters, while being pumped from the double bottom tanks to the distributing tanks on the boat deck.

Other double-bottomed tanks carry the fresh water for the boilers, while in others sea water is carried, if advisable. We carry over 2,900 tons of fresh water when all our tanks are full.

By filling, or pumping out, the sea-water tanks we can counteract to some extent the tendency that any vessel has to list or heel when the wind and sea are pressing hard on one side of the ship. The sea water tanks are usually left empty when leaving port but are filled as ballast to stiffen the ship if necessary as the fresh water and fuel oil tanks are emptied.

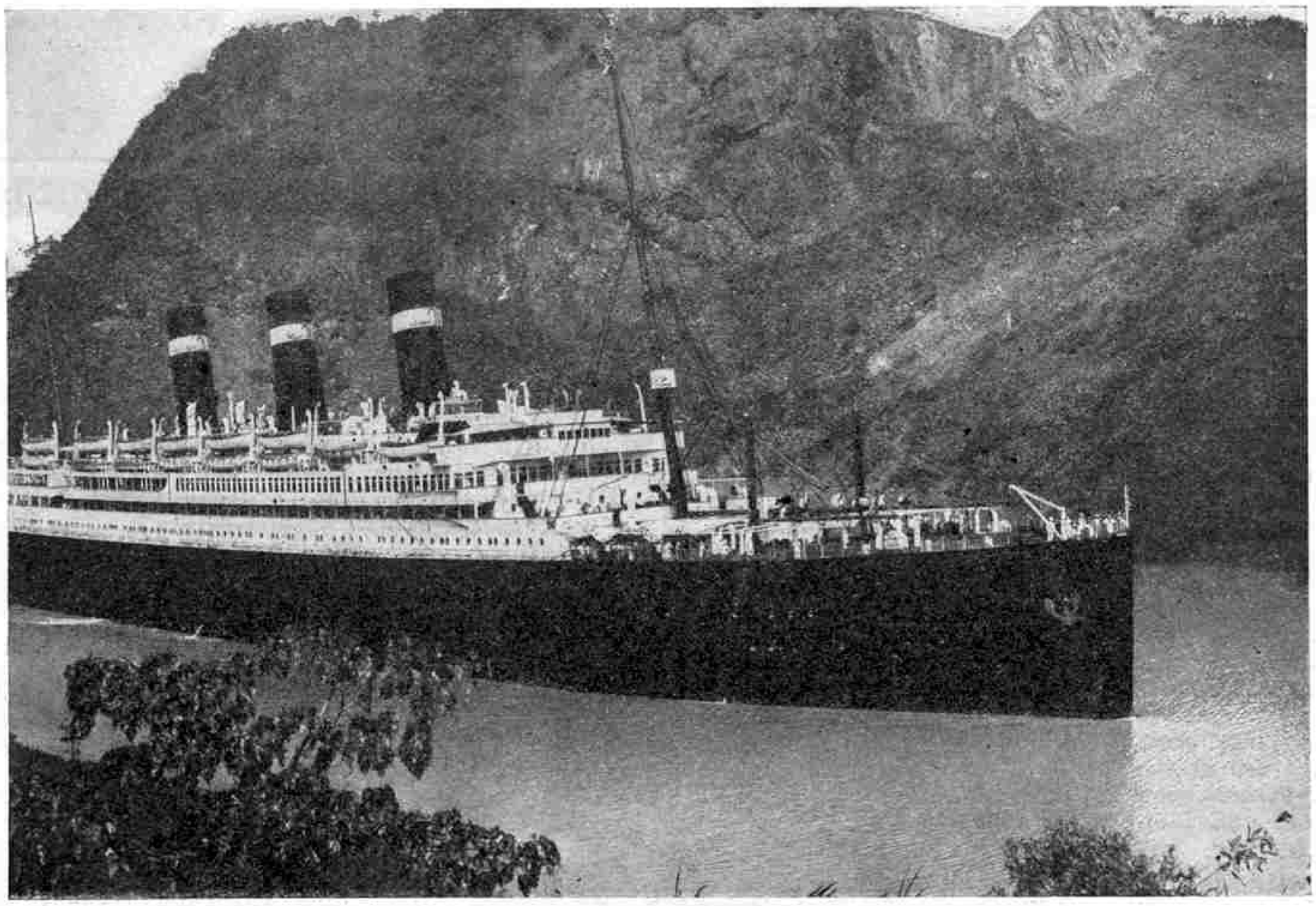
The V-shaped tanks at the bow and stern of the ship, called the forward and after peaks, also serve as water tanks.

When the ship is down to her load draft of about 33 ft., it is 63 ft. from the water-line to the bridge. At this draft she displaces over 35,000 tons of water, the weight of the ship and contents.

The part of the hull up to and including "B" deck

is the structure. It is very strongly formed to take the strains of the vessel labouring in a sea-way. The decks and erections above that deck are constructed of lighter materials, and form the superstructure of the ship. This superstructure is divided into three parts by openings, called expansion joints. These run across the ship and prevent any undue strain coming on the lighter superstructure as the hull bends and twists in heavy seas.

If we watch the brass plates that cover the openings of the expansion joints in heavy weather, the movement can be seen. We thus realise that this great ship, with thousands of tons of steel built into the hull, is flexible. If we could go down into the holds when they are empty, and see the construction—how skilfully and strongly the different parts are riveted, tied and braced, the frames and beams, with the brackets supporting them at the corners—we should further realise how great are the forces of Nature that can distort such steelwork. It becomes increasingly evident how necessary it is that the materials and workmanship should be of the highest class, so that the distortion be only momentary, and that the hull will come back to its designed form as the stresses of the sea abate.



The "*Belgenland*" in the Culebra Cut as she passed through the Panama Canal, 12th December, 1924. The Gold Hill and Cucaracha Slide are to be seen in the background on the right

While the vessel is under construction samples of the materials in the hull are tested by the Board of Trade officials and by the surveyors of Lloyd's Registry of Shipping, so that the vessel may be classed, as the "*Belgenland*" is, 100 A-1 at Lloyds—the highest standard attainable—in their register.

Passengers sometimes ask what the circle and lines on the side of the ship signify. These lines have an interesting history and they carry us back to "the bad old days" in the middle of last century when ships were loaded "down to the scuppers." Many a good ship was posted as missing, until that great man, Samuel Plimsoll, M.P., demanded that a mark be put on the side of the ship to show to where the government experts calculated the ship could be loaded with safety. Hence this line or mark is called the "Plimsoll mark" or "Plimsoll" for short.

In the case of the "*Belgenland,*" and other similar ships, the upper edge of the centre line of the circle or disc is the load draft in summer time, in salt water. At a distance apart is a vertical line with several horizontal lines extending from it. The line marked F.W. means draft in fresh water. That marked "W" load line in winter. Those marked P.-1 and P.-2 are the load lines when the ship is carrying passengers of the third class on the lower decks. The letters L. and R. outside of the circle indicate that the ship is built and operated under the requirements of Lloyd's Register.

Sugar from Trees—(*continued from page* 387)

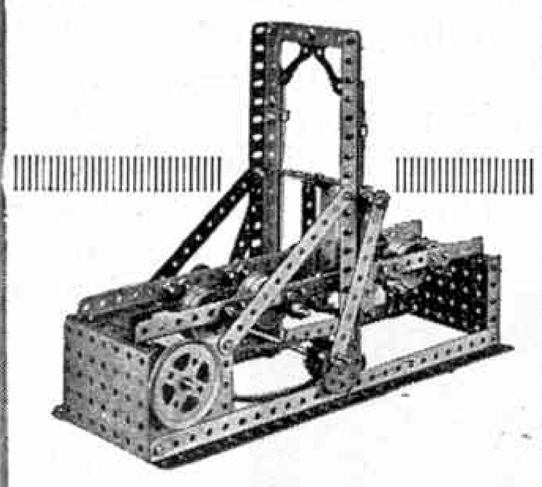
to 60,000 Canadian sugar makers at a time of the year when work is slack for the farmer. The period extends over three or four weeks, commencing about the middle of March, when the days are bright and sunny and the nights frosty. The average maple sugar bush of the farmer consists of 750 trees and can be easily attended by himself and a couple of assistants. Larger groves may have 1,500 to 2,000 trees tapped. It is estimated that altogether over twenty-two million trees are tapped in Canada.

Maple sugar is more extensively exported from Canada than syrup. The chief purchaser is the United States, which imported in 1925 nearly a million pounds of sugar and some 6,000 gallons of maple syrup. The United Kingdom is the next largest purchaser, importing over 25,000 pounds of sugar and about 1,500 gallons of syrup. Other countries importing smaller quantities of Canada's maple products are South Africa, France, New Zealand and Newfoundland.

With all the advances that have taken place in the industry, sugar making has lost none of its romantic side. "Sugaring-off" at the sugar camp is a social event that is looked forward to by both young and old. Picture to yourself the tramp through the wood on a spring day. The sap is running in quick successive drops into the pails and the farmer and his helpers are busily engaged in emptying it into a large tank on a sleigh drawn by a horse. The party are eagerly interested in all that goes on, but their enthusiasm to taste the finished product urges them on to the scene of sugar-making in the sugar house, around which the air is filled with the sweet aroma of escaping steam and boiling syrup.

Pails of clean white snow are brought to the house and dished out into saucers and pans, and on top of this snow boiling syrup is poured. The cold snow immediately hardens the hot liquid into what is called "wax," or "*La Tire*" in the language of the French "habitant." The old-fashioned method was to pour the syrup on to mounds of snow.

The party also inspect the operations in the sugar house and sample both sugar and syrup, each member enjoying the visit all the more keenly because the opportunity of going on a "sugaring-off" party is only presented during a short period in the spring.



Suggestions Section

Edited by "Spanner"

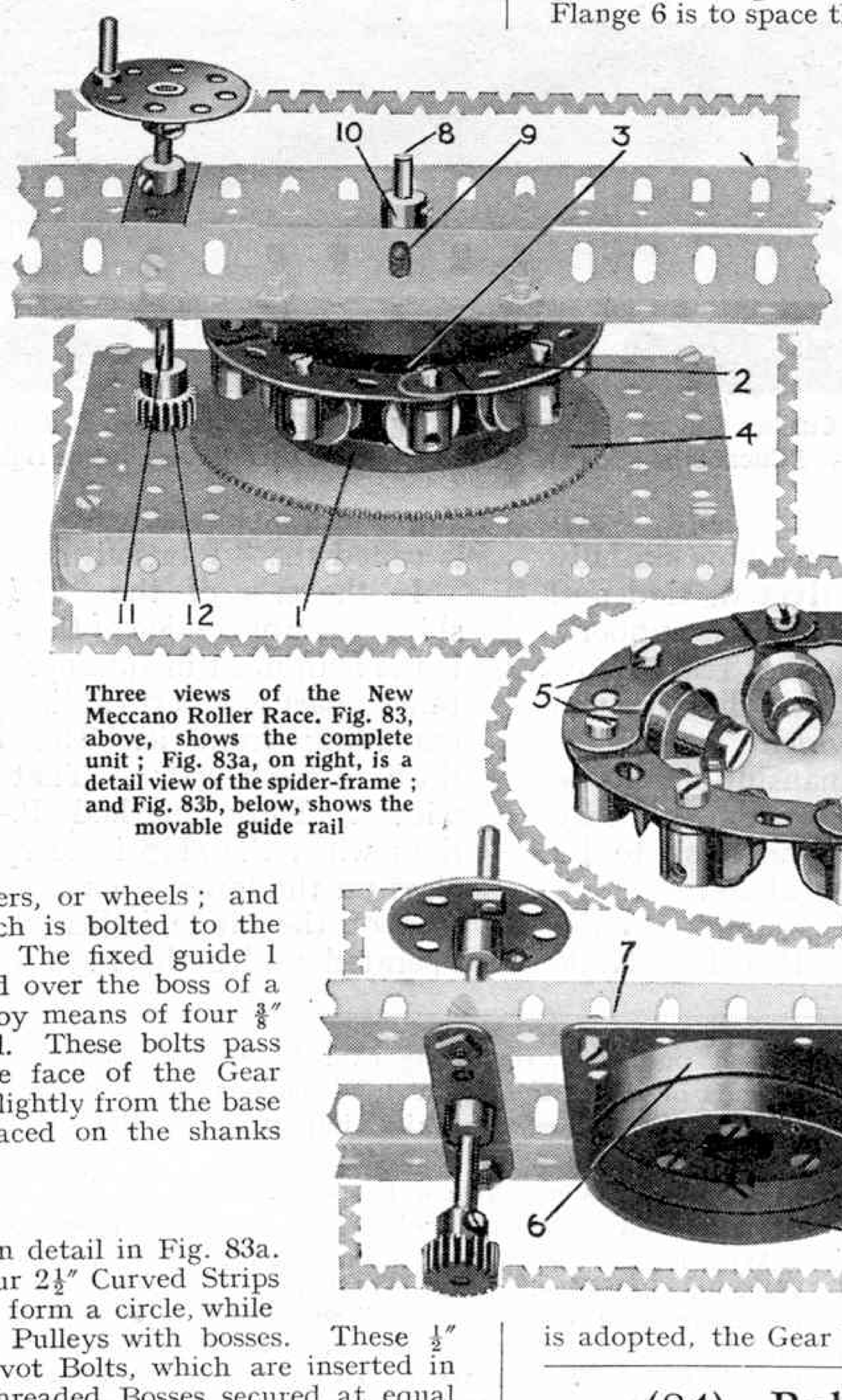
(83)—New Meccano Roller Bearings

(L. V. Harrison, Forest Fields, Nottingham)

IT is explained in the Meccano Standard Mechanisms Manual (Section VII) that when a heavy load is to be rotated about an axis it is necessary to devise some method of relieving the tremendous strain that would be imposed upon that axis. The usual procedure is to distribute the weight of the mass over wheels or rollers arranged at a distance from and rotating round the central pivot.

There are two types of Meccano roller bearing construction described in the Standard Mechanisms Manual. The first of these (S.M. No. 101) is of comparatively massive design covering a large area, and is intended for use in the heavier Meccano structures, such as the Hammerhead and Pontoon Cranes, Aeroscope, etc. The second (S.M. No. 106) is somewhat smaller and is suitable for such models as the Steam Shovel. In addition to these we have now received a suggestion from Leslie Harrison for a very efficient roller race of still smaller dimensions. This is shown in Fig. 83 herewith, and it will be seen that it is particularly well built and is both compact and pleasing in appearance.

It is composed of three principal sections, as follows: the fixed guide rail 1, which is bolted to the base or immovable portion of the structure; the spider-frame 2 carrying the rollers, or wheels; and the movable guide rail 3, which is bolted to the rotating portion of the model. The fixed guide 1 consists of a Wheel Flange fitted over the boss of a 3½" Gear Wheel 4 and secured by means of four ⅜" Bolts to the base of the model. These bolts pass through the perforations in the face of the Gear Wheel 4, but the latter is raised slightly from the base plate by means of Washers placed on the shanks of the Bolts.



Three views of the New Meccano Roller Race. Fig. 83, above, shows the complete unit; Fig. 83a, on right, is a detail view of the spider-frame; and Fig. 83b, below, shows the movable guide rail

Construction of the Roller Race

The spider-frame 2 is shown in detail in Fig. 83a. As will be seen, it consists of four 2½" Curved Strips (small radius) bolted together to form a circle, while the rollers are represented by ½" Pulleys with bosses. These ½" Pulleys are all journalled on Pivot Bolts, which are inserted in the transverse bores of eight Threaded Bosses secured at equal distances round the circular frame by means of ½" Bolts 5. (It will be noted that two Washers are placed between each Boss and the underside of the frame). The set-screws of the ½" Pulleys are removed to permit free rotation of the wheels, while the Pivot Bolts are screwed into the Threaded Bosses until they grip the shanks of the Bolts 5. Care should be taken to see that the Bosses are all secured very rigidly and that the Pivot Bolts are correctly arranged radially to the centre of the spider-frame. It may be mentioned here that several other types of bearings for the Pulleys were tested, but the Threaded Boss arrangement was decided finally to be most efficient.

Fig. 83b shows the movable guide rail. This consists of another Wheel Flange placed with its flat side against the corresponding flat side of a further Wheel Flange 6 and secured by means of four ½" Bolts to the pivoting superstructure 7. The object of the Wheel Flange 6 is to space the guide rail 3 away from the superstructure, thereby securing sufficient clearance for the rolling Pulleys.

Rotating the Superstructure

A vertical Axle Rod 8 secured in the boss of the Gear Wheel 4 serves as the axis of the model. The spider-frame is first placed over this Rod so that the pulleys all rest upon the up-turned flange of the fixed guide rail. The superstructure 7 is then threaded over the Rod so that the Wheel Flange 3 rests upon the Pulleys in the roller race, which thus supports the entire weight of the rotating section of the model. The rolling surfaces so provided reduce friction to a minimum. A Bush Wheel 9 bolted to the superstructure serves as a reinforced bearing for the Rod 8, and a Collar and set-screw 10 secures the whole assembly together.

The vertical Rod 11 and ½" Pinion 12 are intended to suggest a method by which the superstructure may be rotated about the axis 8. The Rod 11 should be driven by a motor or other source of power housed in the superstructure.

The ½" Pinion 12 is in constant engagement with the Gear Wheel 4 and since the latter is fixed to the base, the rotation of the Rod 11 causes the Pinion to travel round the Gear Wheel, thereby turning the superstructure. If an alternative method of operation, such as that described in S.M. 105, is adopted, the Gear Wheel 4 can be deleted, of course.

(84)—Roller Bearings (Alternative Construction)

(S. Riley, Stowmarket)

A suggestion similar to that described above but of more simple design, has been put forward by S. Riley. The principal difference between the two methods of construction lies in the design of the spider-frame, and the latter contributor's method is illustrated in Fig. 84 (see opposite page). In this case the *(Continued on page 441*

(85)—Automatic Safety Device for Lifts

(G. Cunliffe, London, N.2)

From the moment that we board one of the big passenger lifts with which most "underground" railway stations are equipped, until a few seconds later when we hurry out in search of our train, scores of feet below, the safety of our limbs and our very lives depends on a maze of mechanical marvels. We all know the story of the dear old lady who, armed with a ticket for Piccadilly Circus, boarded a lift at Earls Court and refused to get out on reaching platform-level because she had "still seven stations to go," and it is interesting to wonder what would be the feelings of this simple old soul if she were told that the huge lift and its occupants were suspended over a gaping chasm merely by a slender cable! But any fears that she might entertain would be groundless.

Although every lift on the Underground Group of electric railways in London handles each year something like $1\frac{3}{4}$ million people, the records show a wonderful freedom from accidents. This fact speaks very highly for the efficiency and vigilance of the engineers and attendants concerned. Even their united efforts would be of little avail, however, but for the reliability and precision of the complex machinery involved. All manner of ingenious devices are employed with the object of bringing any possibility of breakdown to an absolute minimum.

Meccano boys have often shown their appreciation of the importance of applying the "Safety First" maxim to all machinery that is required to serve the public, and the interesting apparatus illustrated on this page indicates the close attention that at least one reader pays to this vital detail.

Object of the Device

G. Cunliffe's suggestion is in the form of an automatic locking device designed to prevent serious damage in the event of breakage of the lift hoisting cable. If such an accident occurs, the device promptly wedges the lift or cage fast in the shaft, where it remains until the necessary repairs are effected or until the passengers can be extricated. A similar arrangement is employed on many lifts in actual practice.

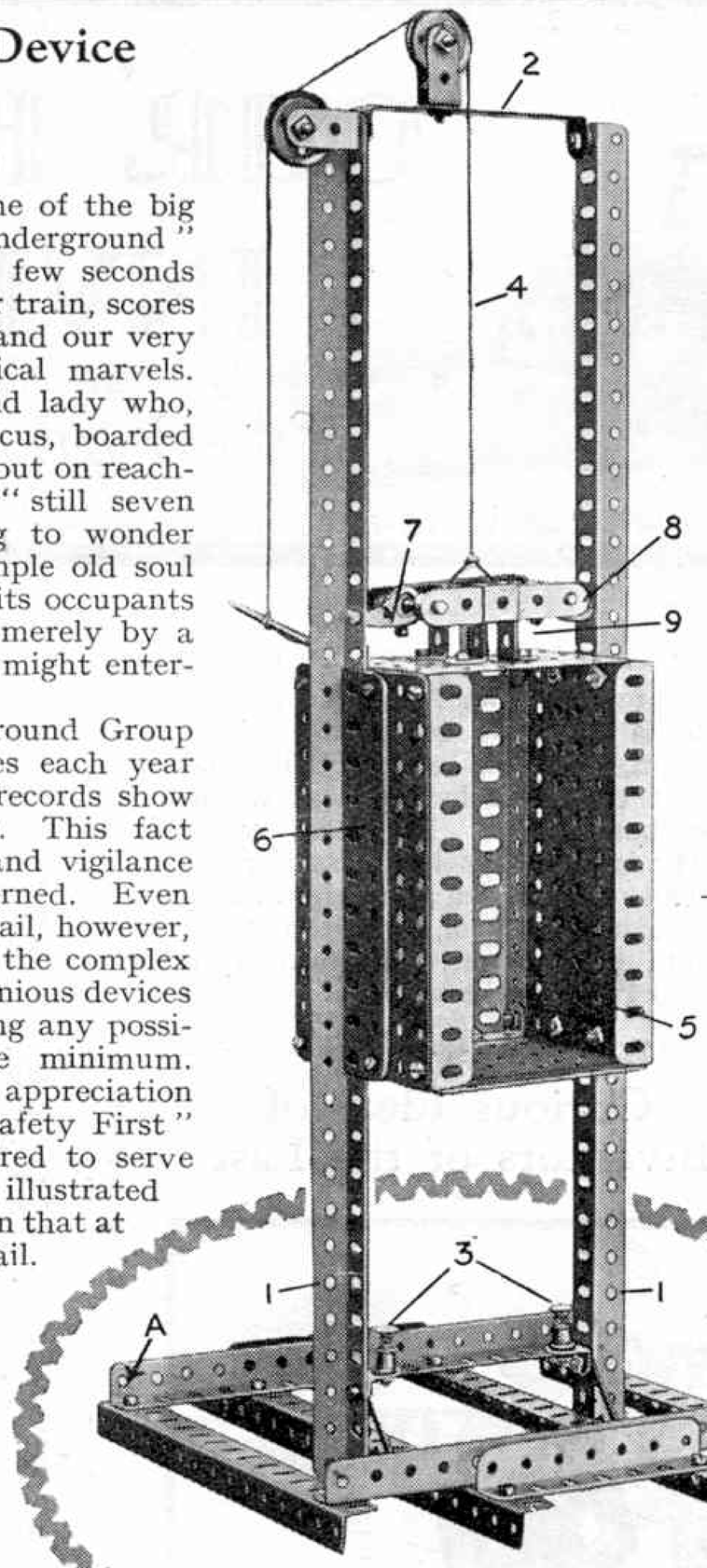
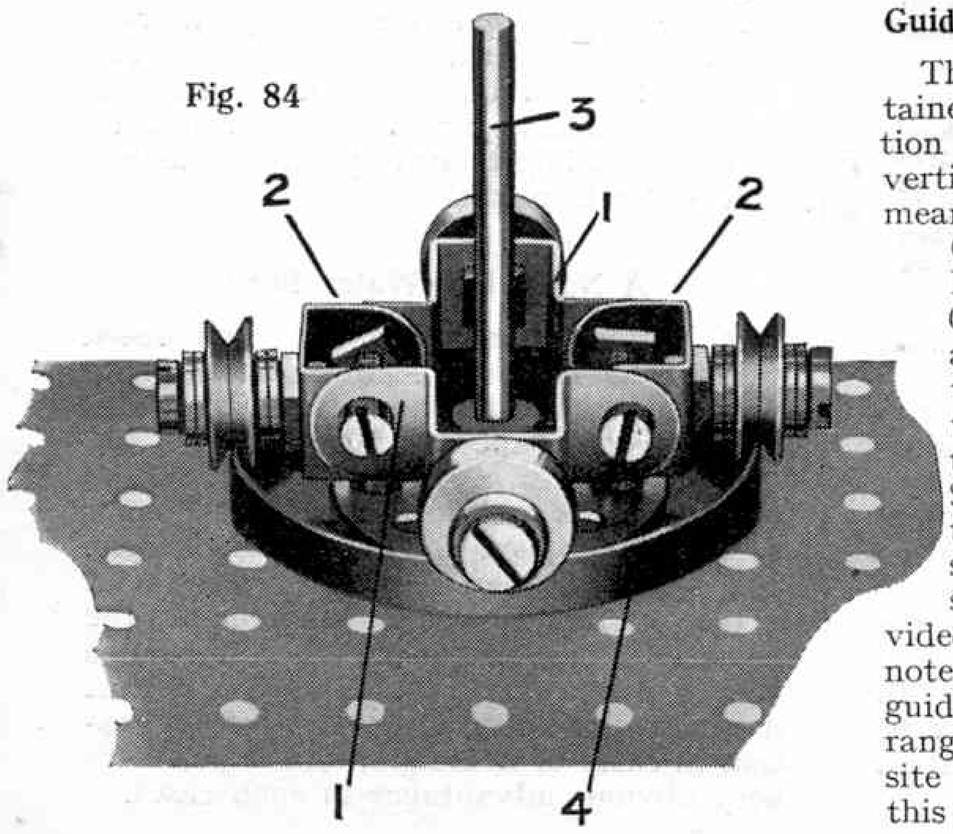


Fig. 85

Fig. 85 shows the lift and special demonstration frame. The latter consists of two vertical $18\frac{1}{2}$" Angle Girders bolted to any suitable base and connected together at their upper ends by a $3\frac{1}{2}$" Double Angle Strip 2. (Three Washers are inserted between one end of the Strip 2 and the Angle Girder to obtain the necessary spacing). The lift itself may be of any desired type, of course. That shown in the photograph is built up from $3\frac{1}{2}" \times 5\frac{1}{2}"$ Flat Plates 5, which form the sides, and $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates and $3\frac{1}{2}"$ Double Angle Strips, representing the roof and floor. Spring Buffers 3 provided at the base of the shaft act as "cushions" for the descending lift.

Fig. 84



Guiding the Lift

The lift is retained in position between the vertical guides by means of $5\frac{1}{2}$" Flat Girders 6. Each Girder 6 is spaced away from the side of the lift by two $5\frac{1}{2}$" Strips, and the Girders 1 slide in the slots so provided. It will be noted that the guides are arranged in opposite positions; this prevents any movement of the lift except in a vertical direction.

The safety device is shown in detail in Fig. 85a. Two Pawls 7 are secured to 2" Axle Rods, which are journalled in the ends of two pairs of $1" \times 1"$ Angle Brackets 8. These Brackets are bolted together in the manner shown and secured to the top of the lift by four $1" \times \frac{1}{2}"$ Angle Brackets 9. The same bolts that secure the latter carry Double Brackets 10, which serve to strengthen the whole construction. It may be mentioned here that this arrangement of the bearings for the 2" Rods was found necessary in order to space the Pawls at the exact distance required from the vertical guides 1.

The hoisting cord 4, which, of course, may be controlled by any suitable machinery, is divided in two and connected to the set-screw of each Pawl 7. A piece of Spring Cord 11 secured between the Pawls tends to retain them in a horizontal position. When the cord 4 takes the weight of the lift, however, the Pawls are pulled downward and their ends brought clear of the Angle Girders 1. The lift is now free to move up or down. If the hoisting rope breaks the Spring 11 returns the Pawls to their original position, with the result that their ends engage the holes in the Girders 1 and the lift becomes firmly locked in position.

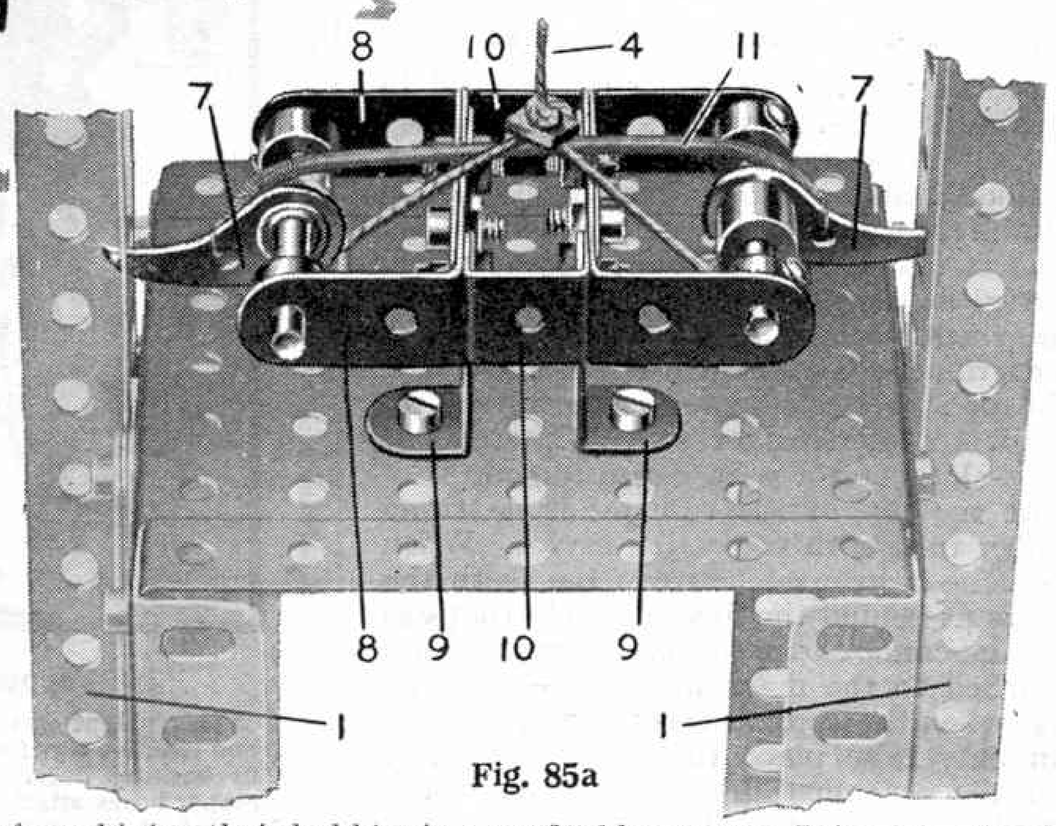


Fig. 85a

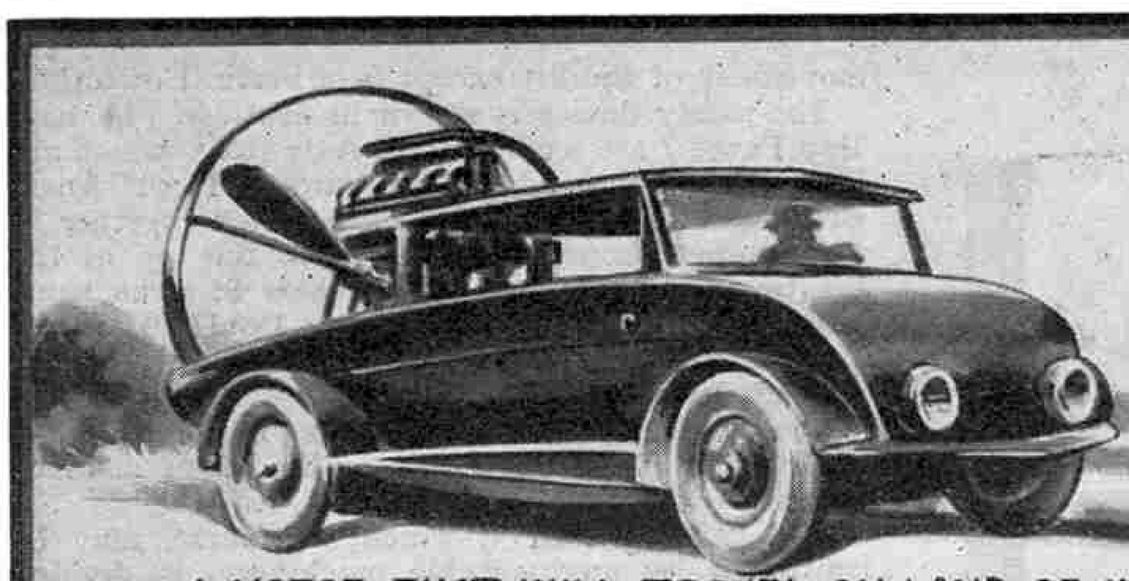
Miscellaneous Suggestions

Under this heading "Spanner" replies to readers who submit interesting suggestions regarding new Meccano models or movements that he is unable to deal with more fully elsewhere. On occasion he offers comments and technical criticisms that, he trusts, will be accepted in the same spirit of mutual help in which they are advanced.

(M.1). **Retort Stands.**—Many suggestions deal with the construction of retort stands and adjustable clamps with which to secure test tubes when making chemical experiments, and it is evident that Meccano boys who are interested in chemistry have found a means of combining their hobbies in a profitable manner. It is a very simple matter to construct clamps or stands for the purpose mentioned, however, and we are therefore of the opinion that our space may, perhaps, be put to more generally useful purposes than that of illustrating a specimen model. *(Reply to Andrew W. Inglis, Coatbridge; B. Flavell, West Melton, and others).*

(M.2). **Stub Axles.**—Your suggested mounting for the front wheels of a motor chassis offers no important advantage over existing forms of Meccano stub-axle construction. By means of slight alterations, however, it could be converted to the correct Ackermann design. *(Reply to W. Lowthian, Birkenhead).*

(M.3). **Reversing Gear.**—Your device is based on the principle of ordinary belt reversing gear (Standard Mechanism No. 18) but gear wheels are used to change the drive from one of the belts to the other. We find that the apparatus works very well, but we consider that it is unnecessarily elaborate. *(Reply to H. F. Barnard, Shepherds Hill, Merstham).*



OUR BUSY INVENTORS

RECENT INTERESTING PATENTS

A MOTOR THAT WILL TRAVEL ON LAND OR WATER

Amphibious Motor-car

The remarkable looking vehicle illustrated above can travel with safety in water or on snow and ice, as well as on the road. It is fitted with a 70 h.p. aeroplane engine, and is capable of attaining a speed of 60 miles an hour on land. When travelling on water it is kept afloat by airtight pontoons fitted along both sides underneath the running boards, and these pontoons help the machine to keep afloat and maintain its balance. Two layers of wooden boards, crossed with canvas water-proofed between both, comprise the top, making it water-tight and seaworthy.

The car, which is stated to be the idea of a Bangor garage-man named George McLaughlin, resembles a fine limousine in its finish and equipment.

Inventors have been busy for some time trying to perfect a vehicle of all-round usefulness in transport, and now matters have progressed so far some interesting developments may be looked for.

* * * *

Gas-Masks for Everyday Use

Railway workers are often compelled to breathe smoke-laden air and this has led to the introduction of a simple type of gas-mask that can be adjusted quickly on entering a tunnel or in similar circumstances. This is made of a canister that is easily carried in the pocket, and is filled with an absorbent, usually a mixture of soda-lime and granular charcoal, to remove foul gas. The end of the canister is perforated to admit air, and grit or soot is filtered out by a cloth and a wire gauze screen.

At the top of the canister is a strong rubber tube with projecting leaves. When the tube is gripped between the teeth the leaves fit behind the lips so closely that gas leakage cannot take place. A small clamp attached to the mask fits on the nose, so that when the apparatus is worn, breathing can only take place through the mouth, and the air must first pass through the filters in the canister. The whole apparatus is so light that no additional support is necessary beyond the grip of the teeth of the wearer.

* * * *

A Wear-Resisting Coating for Metals

Much interest has been taken lately in processes for coating the surface of a base metal with a wear-resisting alloy. The base metal may possess such virtues as lightness or cheapness, but these are often counterbalanced by lack of resistance to corrosion. Two distinct processes have been developed for this purpose, one of which is purely chemical while the other is mechanical.

"Stelliting" Metals to Resist Wear

This process is an American invention. Stellite is an alloy consisting chiefly of chromium, tungsten and cobalt, and is of about the same hardness as hardened high-carbon steel. Its most valuable property is that this hardness is retained practically in full even at a bright red heat. As a coating for steel, cast iron, wrought iron, and even copper, it has already been found to be of great value.

Curious Ideas of Inventors of the Past

(2) Pepper Gun for Cyclists

This patent was granted in 1899 for a novel and effective way for a cyclist to repel the attacks of barking dogs. The invention consisted of pepper boxes attached to tubes leading to a bulb placed at the centre of the handlebars. When the cyclist pressed the bulb, it shot a cloud of pepper into the face of the dog.

The metallic surface to be coated with stellite must first be cleaned thoroughly, preferably by grinding, and then a layer of stellite is welded to it with the aid of an oxy-acetylene blowpipe. The first operation has to be carried out with great care to secure a thorough bond between the stellite and the underlying metal, and blowholes or flaws must be absent. In addition an excess of acetylene must be present in the flame to prevent oxidation of the alloy.

When the first layer of stellite has been thoroughly welded on, other layers are added until the required thickness has been built up. Stellited metal has already been used to make the drag chains used for pulling away white hot clinkers in the manufacture of cement, the resisting power of the new alloy enabling it to retain its hardness in spite of the heat to which it is subjected.

A Chemical Process

A somewhat similar result is obtained by chemical means, this particular invention concerning aluminium and its alloys.

The principal drawback to the use of these light metals is that they are readily corroded by exposure to the atmosphere. This corrosion can be prevented by coating the aluminium with a mixed deposit of chromium and silver. The aluminium to be coated is placed in a bath containing an alkaline solution of salts of chromium and silver, when the deposit required is produced on the surface. This coating is achieved by purely chemical means, and can be made brighter by an addition of about 10-20 per cent. of glycerine. When a particularly thick and resisting coating is required an additional layer is applied by electro-chemical means, this additional layer adhering much more firmly to the first layer than it would if produced directly on the aluminium. A further interesting point is that the coating is available in various colours.

One instance of the use of this process is in the construction of motor-car bodies. A greyish-blue coating resembling glazed porcelain, has been found most suitable for this, as it is very brilliant, resists mechanical injury, and can be washed with hot or cold water. The same material is an excellent substitute for the more expensive copper in the construction of electric and scientific apparatus, and official tests in the German Government laboratories have shown that the resistance of these coatings to atmospheric agents and salt water is remarkable.

* * * *

A Novel Hot-Water Bottle

A homely invention of undoubted utility has recently been produced by a woman inventor in Ohio. It is a hot-water bottle in the shape of a face mask.

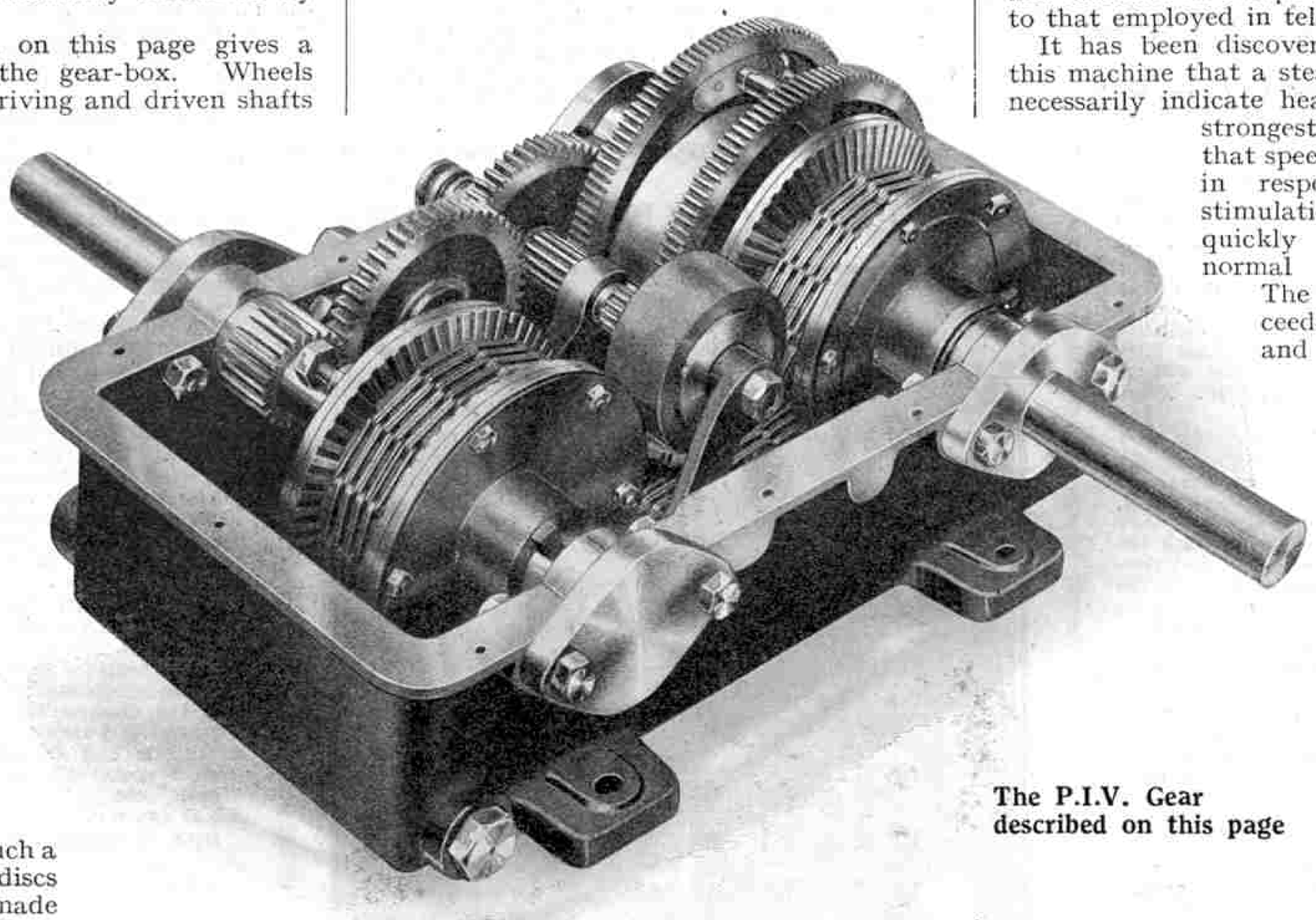
It is simply a double-walled rubber mask that is provided with head-bands so that it fits over the face of the wearer. The space between the walls holds about a pint of liquid, and although light, the mask is so designed that it does not bulge at any point when full. The idea is that it can be filled with hot water for application in cases of neuralgia, and it possesses very obvious advantages in such cases.

A Continuously Variable Gear-Box

A British invention that is likely to bring about a revolution in the motor trade is a new method of gear-changing. The method now in use is no doubt familiar to all readers of the "*M.M.*," and while it has proved itself the best practical device so far produced, its defects are painfully obvious—especially to those learning to drive! The difficulty is to make the gear-wheels mesh cleanly and silently while they are rotating at high speeds. In the new gear-box the variations are not produced by bringing new gear-wheels into mesh, but by changing the effective diameters of two wheels permanently connected by a chain.

The illustration on this page gives a general view of the gear-box. Wheels mounted on the driving and driven shafts are each made up of a pair of expanding conical-disc pulleys. These pulleys are free to slide on their respective shafts, and when the two parts of one wheel are brought together the chain is forced up to the edge of the cone, slipping down towards the centre when the discs recede from each other. The pivoted arms at each side are connected to the pulleys in such a way that when the discs on one shaft are made to approach each other, the discs on the other shaft move further apart. Thus the movement of the gear handle controlling the arms brings about a continuous variation in the gear-ratio.

The chain transmitting the drive is specially made to fit the pulleys in all positions. The actual construction of both the wheels and the chain involves many features of great practical interest, and in view of its importance a complete description of this British production will appear shortly in the "*M.M.*"



The P.I.V. Gear described on this page

* * * *

Electric Hammer

At the recent New York Electric Exhibition an electric hammer was shown. It weighs 10 pounds, is operated by a 1/6th horse-power motor, and delivers 2,400 blows per minute.

The small motor inside the case of this tool continuously rotates a roller through a circular path. The hammer itself operates in guide rollers, and is lifted and dropped by an eccentric motion imparted to it through the main roller. In the main part of the hammer a slot in the shape of a quarter of a circle is cut of such a width that the main roller moves freely in it. As the roller rotates it moves round the slot gradually raising the hammer, until it reaches the end of the track. At this point, the hammer is at its maximum height and is then dropped on to the work.

Daylight Glass for Light Fixtures

A new idea has occurred to an American inventor. In order to imitate daylight as closely as possible when artificial light is being used he has constructed a new form of glass in which three different layers are fused together. The first of these is blue to make a miniature sky. This is followed by white glass to give the effect of reflection from clouds, and finally by a clear layer that is to act in the same manner as the atmosphere. When the glass is used in making electric light bulbs, the resulting light is stated to have all the qualities of daylight.

Branding Two Thousand Walnuts a Minute!

The Walnut Growers' Association of California offered £2,000 as a reward for the invention of a machine that would stamp their trade-mark on the nuts grown by them. Nine thousand replies and 150 working models were investigated by them and finally they selected a machine invented in Los Angeles.

The difficulties in the way of the construction of such a machine were two—first that the surface of the nut is uneven, and the second that the shells crack easily under pressure. The machine uses dies made of sponge rubber, which stamp the trade mark in printer's ink on the shell in spite of the uneven nature of the printing surface. The nuts are placed in cups arranged in rows on a cylinder. The rotation of the cylinder carries each row of nuts in turn under a set of these dies, and the continuation of the movement of the cylinder allows the nuts to drop out after stamping. The pressure of the dies is adjusted to give a good contact between the rubber and the shell without breaking the latter.

About 125 of these machines have been brought into use in the packing houses of the Association throughout California, where 95 per cent. of the walnuts grown in the United States are handled. Each machine is capable of stamping 2,000 walnuts a minute at a very moderate cost.

A Mechanical Pulse Recorder

A device produced by an American engineer has thrown new light on the value of pulse indications for diagnosis. The inventor calls his machine "a mechanical hand for feeling the pulse, which will substitute exact and complete information about heart action for guesses doctors make from their own sense of touch." The apparatus is in two parts, one for attachment to the wrist and the other for recording, the latter being actuated by a small electric motor. Two cables connect the parts of the apparatus together and every movement of the pulse is amplified and recorded on a tape in a manner similar to that employed in telegraphic recorders.

It has been discovered by the use of this machine that a steady pulse does not necessarily indicate health, and that the strongest heart is the one that speeds up most quickly in response to external stimulation and just as quickly returns to its normal state afterwards.

The pulsemeter is exceedingly sensitive, and even the effect of a laugh on the beat of the heart can be traced with its aid. It was used to register the heart beats of a motor-car driver during a city drive and readily showed how his heart responded to every traffic signal, every narrow squeak, and every short stop, while in another case a boxer registered his feelings during a contest simply by thinking through an imaginary fight!

* * * *

A New Electrical Insulator

A patent has been taken out for a simple but ingenious form of insulator that is particularly suitable for use in the erection of wireless aerials. It is bell shaped, with an external ring for the suspension rope and an internal one for the aerial wire, these being at the closed end. The lead-in wire is passed through a hole in the side of the insulator and is connected to the aerial inside.

The insulator may be constructed of any suitable material, but the inventor prefers glass. Adequate protection from rain is afforded to the joint.

* * * *

A Life-Preserving Bullet!

An invention that comes from Chicago has a distinctly novel idea behind it. It is a very difficult matter to secure a live gorilla or an orang-outang, but it is quite easy to shoot one. Captain Harris, of the Chicago Zoological Society, has therefore devised a bullet with which animals may be shot alive instead of dead. The bullet contains a chemical substance which is released when the animal is struck. This substance penetrates into the blood and produces temporary unconsciousness in the animal, which then can be captured without difficulty.

In Reply

In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used.

Suggested New Meccano Parts

LARGE BASE PLATES.—Your proposed 12½" × 2½" Flat Plate would be applicable to few models, and would tend to complicate the system unnecessarily. When large plates of this description are required it is usually possible to build them quite easily with two or three of the existing Plates. (*Reply to E. Jones, Norwich*).

THREE-SIDED BRACKETS.—As previously mentioned in these columns we consider that the difficulty of standardising a three-sided bracket with the existing system more than outweighs the advantages that would accrue from its introduction. Moreover, two Angle Brackets can be used to serve the purpose you have in mind. (*Reply to W. Allen, Winnipeg*).

NEW CURVED STRIPS.—We note that you suggest the introduction of new lengths and radii in Curved Strips. The possibility of manufacturing this part to contain 3, 7, 19, and other quantities of holes will be considered further. (*Reply to W. Allen, Winnipeg*).

TUBULAR ELEMENTS.—Probably you have noticed from recent issues of the "*M.M.*" that we have under consideration a number of suggestions concerning curved plates, boilers, and other tubular parts. It is very difficult to standardise such parts with the existing system although we agree that they would prove of value in connection with the construction of large ship's funnels, gear barrels, locomotive boilers and cylinders, etc. Much attention is being given to the subject, however, and numerous experiments are being made. Meanwhile we shall be pleased to consider any further proposals on these lines. (*Reply to A. Wright, Coventry; J. Carmichael, Perth; J. Knowles, Birmingham; E. Rice, Dorking; C. G. Harmer, London, S.E.; D. J. Roberts, London, N.13; A. G. Tatford, Portsmouth; L. Ison, Northcote, Victoria; and A. F. Ward, Oxford*).

NEW ANGLE BRACKETS.—We note that you suggest the introduction of a Bracket, angled at 135 degrees, but we doubt whether this part would fulfil any important functions. In the few cases where such a part is required, no difficulty should be found in bending one of the existing Angle Brackets to the required shape. (*Reply to D. Hunter, Barrow-in-Furness, and I. W. Scott, Westbury-on-Trym, near Bristol*).

CURVED GIRDERS.—Although we fear the adaptability of curved Girders would be somewhat limited we are keeping a careful record of all contributions supporting this suggestion. (*Reply to F. Bath, Parkstone, Dorset, and F. Illingworth, Haslingden*).

SHIP'S VENTILATORS.—Ship's ventilators could be used for one particular purpose only, and therefore their introduction is not justified. It should be possible to build realistic substitutes from existing parts. Incidentally, with reference to the Ship's Funnels (Part No. 38) we may say that these parts can be used for many purposes in addition to ship-building; they are often employed, for example, to represent cylinders and chimneys for steam cranes, locomotives, shovels and many other steam-operated appliances. (*Reply to M. W. Spencer, Halifax*).

CIRCULAR RACK STRIPS.—Your suggestion regarding a circular rack strip with both internal and external teeth is interesting and is receiving attention with other proposals of a similar nature. (*Reply to F. Conradi, Croydon*).

POINTER.—We are considering the possibility of introducing a special Meccano pointer for use in balances, etc. Meanwhile we may say that the existing Centre Fork forms an efficient substitute. (*Reply to L. Henley, Gillingham*).

"HEART" CAM.—A heart-shaped cam would fulfil very few important functions in the Meccano system and almost any desired cam movement may be produced without much trouble by means of the existing parts. See Standard Mechanisms Nos. 264, 265 and 266. (*Reply to J. McManus, Derry, and C. K. Radcliffe, Southampton*).

STEERING WHEEL.—The specially-designed steering wheel that you describe would no doubt improve the appearance of the Meccano motor chassis. On the other hand it would be principally ornamental and could be used for few other purposes. The 2" Pulley Wheel answers very well as a steering wheel for the chassis, and the appearance of this part can be improved by fitting a small rubber ring round its groove. (*Reply to C. Faulkner, Cheadle Hulme*).

MECCANO PLIERS.—The introduction of a small pair of pliers for use when connecting Sprocket Chain or Spring Cord seems scarcely necessary, although a tool similar to the one you describe is included in the Hornby Control Set, and may also be obtained separately, price 1/6. (*Reply to A. Robbins, Welton, near Daventry*).

SPECIAL COUPLINGS.—We note your suggestion regarding the introduction of a special Coupling with square bore at one end to fit the key-shaft of the Clockwork Motor, with a view to making possible the connection of the shaft to Meccano Rods so that the Motor spring may be wound from a distant point. We regret that the scope of such a part would be too limited, however. (*Reply to John Hayman, London, N.W.2*).

DETACHABLE CRANK HANDLES.—A bent rod ending in a Coupling or Collar with set-screw would certainly form a useful detachable crank handle. On the other hand it is a perfectly simple matter to construct handles of all descriptions from existing Meccano parts and therefore your proposed part would merely duplicate some of the functions of existing elements. See Standard Mechanisms Nos. 255 to 259, etc. (*Reply to Philip Pottier, Purley*).

MECCANO SOUND BOX.—The introduction of a special sound box suitable for use on a Meccano gramophone is not in accordance with our usual practice and we regret that we are unable to entertain this idea, at least for the present. Several suggestions for Meccano models of sound-boxes have been received, however, and if these prove successful an article on their construction will probably appear in a future issue of the "*M.M.*" (*Reply to C. Lester, Aylesbury*).

CATERPILLAR TRACKS AND TRACTOR WHEELS.—Your suggestions regarding the introduction of caterpillar tracks and tractor wheels for model tanks, farm tractors, etc., are interesting but we are of the opinion that the demand for such parts would be comparatively small. It is possible to devise a realistic and efficient caterpillar motion from Sprocket Chains and large Sprocket Wheels, etc. (*Reply to C. A. Aldridge, Rio de Janeiro*).

DISC WHEELS.—We are interested in your suggestion regarding the introduction of steel discs for attachment to the 2" and 3" Pulley Wheels for use on motor cars, and we shall give further consideration to it later. (*Reply to F. Kenyon, Penrith, Cumberland*).

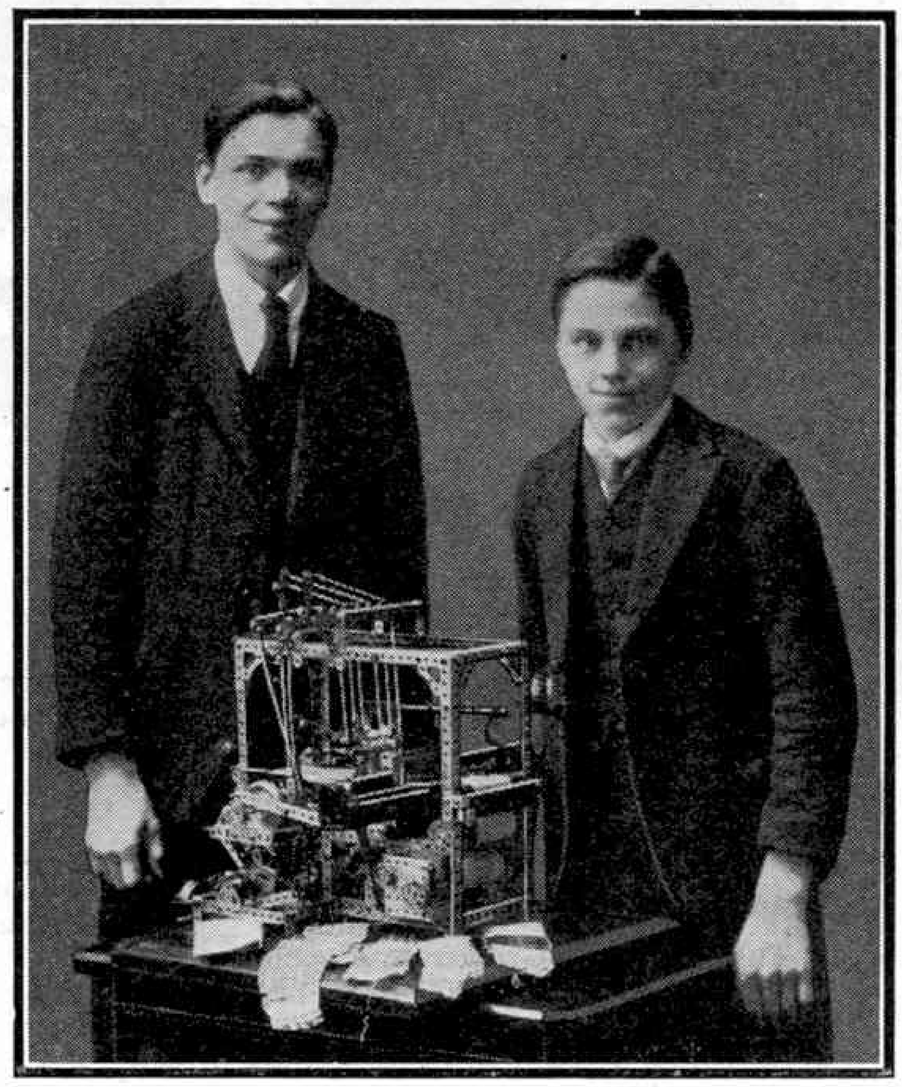
KEYED RODS.—The question of introducing Axle Rods upon which wheels can slide longitudinally while rotating with the axle continues to occupy our attention. Many suggestions have been put forward and experiments are being continued. We hope to make an announcement in the near future on this subject. (*Reply to D. Bowden, Basingstoke*).

MECCANO RIVETS.—Although we are interested in the suggestion that rivets should be introduced as alternatives to Nuts and Bolts, we regret that we are unable to comply with your request. It would be impossible to obtain the same rigidity of construction with the type of rivet that you describe; moreover, a spring-clip rivet would not be at all realistic. (*Reply to E. Morris, Chesterfield, and R. Brotherton, Huddersfield*).

COMPRESSION SPRINGS.—We shall consider your proposal re compression springs. As you remark, the spring included in the Buffer (Part No. 120a) is suitable for many purposes and where a larger compression spring is required it is possible to convert the existing tension Spring (No. 43) to the compression type by first extending it and so opening out the coils. This method was adopted in the Meccano Spring Pistol described under Suggestion No. 23 (see "*M.M.*" for March, 1926). (*Reply to P. Roos, London, W.12*).

NEW WORM WHEEL.—As stated a few months ago, we are unable to introduce a Worm of larger pitch as this would entail the addition of a complete set of new Gear Wheels to use in connection with it. We shall go further into the possibilities of a Worm with a two-start thread, although we are of the opinion that such a part would prove very expensive to manufacture. (*Reply to W. Marsden, Ilford, Essex, and J. R. Hughes, London, S.E.3*).

CLEVER MECCANO WEAVERS



Our photograph shows George and Craven Gould, of 15, James Street, Oakworth, near Keighley, with their Meccano Loom. These two clever Meccano boys have improved and amplified the design of the well-known Manual model to such good purpose that they are able to produce a wide variety of beautifully-coloured cloths, in striped, check and plaid patterns.

George and Craven are both apprenticed to the loom-building industry and they tell us that they derive a great deal of valuable information from building models of this description. That they are already well versed in the intricate subject of weaving is shown by the realistic details of their model loom.

In their model the take-up motion, which rolls the woven cloth on to the piece roller, consists of a range of wheels operated by pawl and ratchet gear. The shedding movement is obtained by tappets and treadles, which raise the heald frames in consecutive order, the frames afterwards being returned by spring controls. The tension of the warp is regulated by a weighted lever, which allows the warp to be paid off the beam at an even speed according to the number of picks per inch required. As the diameter of the warp on the beam grows less, the weight is moved nearer to the fulcrum of the lever by means of a runner on the warp, thus easing the tension.

The model shown in the illustration was exhibited, together with a collection of typical examples of its work, in the window of Mr. W. Bruce Johnston's establishment, which, as all local Meccano boys know, is situated in Lawkholme Crescent, Keighley.

Suggested Hornby Train Improvements

ADVERTISEMENT HOARDINGS, ETC.—Field advertisement signs, hoardings, and similar decorative accessories, while complicating the system, would serve no really useful purpose. Moreover, they may be constructed very easily at home when required. Half the fun of a model railway lies in devising various accessories of this kind to one's own design and requirements (*Reply to N. E. Woods, Earlsfield, S.W.*18).

C.P.R. TRAIN SET.—We regret we are unable to consider the introduction of a Canadian Pacific Train Set at present, but we may give further thought to the idea some time in the future. (*Reply to W. and H. Charteries, Dumfries*).

HORIZONTAL STEAM-ENGINE.—Your idea for harnessing a horizontal steam-engine to a 4-volt generator and using the current so produced to work a Hornby railway is interesting, but a large and expensive plant would be required to do this. The manufacture of a steam engine to serve the purpose is, we fear, outside our usual practice. (*Reply to W. F. Fox, Thornton Heath, Surrey*).

DINING CARS.—Dining Cars were included in the system at one time but were withdrawn owing to the fact that a Pullman Train, as supplied a few years ago with one Pullman and one dining car, provided exactly the same amount of space for eating meals as it did for carrying passengers, whereas in actual practice a normal train would comprise five or six ordinary coaches to every dining car. It is true that some demand might be found for dining cars if they were introduced as special accessories and the matter will have attention. (*Reply to S. Harrison, Wembley; B. Partington, Hull; and J. Miller, J. Robbins and L. Hall, London, N.W.*2).

COUPLED WHEELS FOR No. 1 LOCOMOTIVES.—So far we have been unable to go more deeply into the matter of coupling the wheels of No. 1 engines, but we hope to carry out experiments in this connection in the near future. (*Reply to J. Summersall, Oxford, D. C. Young, Sheffield, and many others*).

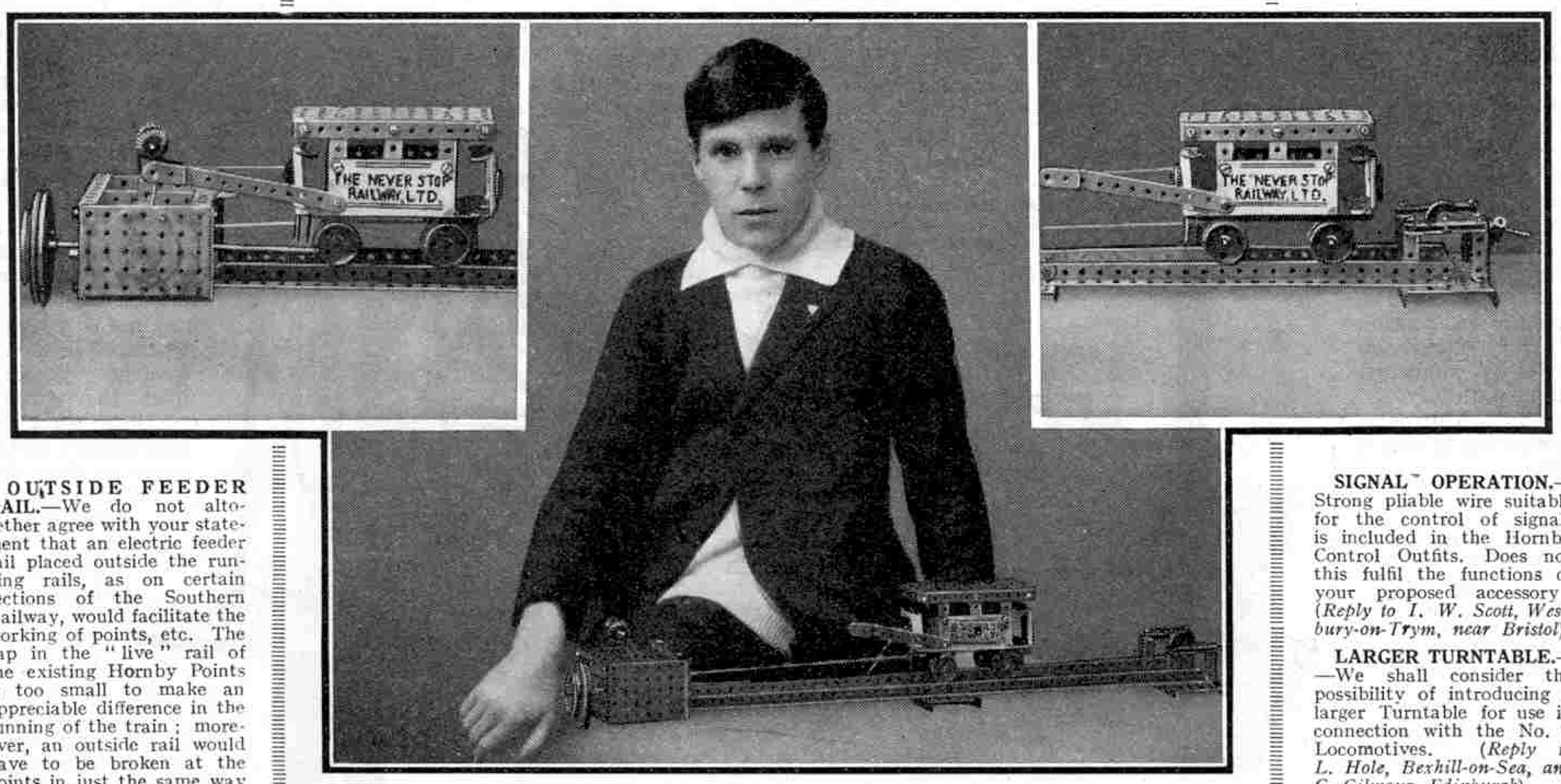
ELECTRIC CROSSOVER.—We are experimenting with a view to introducing a Crossover fitted with a centre "live" rail. (*Reply to T. A. Metcalf, Elstead*).

STEAM LOCOMOTIVES.—We regret that we are unable to adopt your proposal regarding the introduction of steam locomotives. As we have stated previously, clockwork and electricity are by far the most popular forms of motive power in small model railways. (*Reply to W. Hodgkinson, Fleetwood, and E. Barry, Cardiff*).

ARTICULATED LOCOMOTIVE.—This type of locomotive would be very expensive to produce and we doubt whether it would prove popular even if it were possible to introduce it into the Hornby system. (*Reply to F. R. Martin, Southampton*).

VESTIBULE CONNECTION FOR COACHES.—We note your suggestions regarding vestibule attachments for the Hornby Pullman coaches similar to those fitted to the Blue Train, and we shall give the matter further consideration. (*Reply to F. G. Moody, Wimbledon Park, and E. Winter, Cheltenham*).

A MECCANO "NEVER-STOP" RAILWAY



Philip T. Atkinson (aged 14) of Stockton-on-Tees, is seen above with an interesting model of a "Never-stop" Railway that he has recently perfected. The construction of the railway is based on Model No. 405 in the Complete Manual, and the operating mechanism is equipped with an ingenious automatic reversing device.

When the car reaches one end of its run the reversing lever, which is suitably weighted at its upper end, is struck and thrown over by an arm protruding from the car, as shown in the left-hand inset. This reverses the mechanism, which is similar in principle to Standard Mechanism No. 66, and the car returns to the opposite end of the track. At this point it draws tight a cord connected to it and to the weighted lever, with the result that the latter is pulled back to its original position and the motion of the operating machinery is once more reversed. Hence the car is caused to travel continuously to and fro for so long as the driving spindle is rotated, whether by hand or motor.

An interesting feature of the model is the cord tightening device fitted to the outer end of the runway. The truck operating cord passes over a 1" loose Pulley mounted in a Cranked Bent Strip, which is secured by means of two nuts to the end of a 2" Threaded Rod. The other end of this latter Rod passes through a Strip secured to the bed-plate and is fitted with a Threaded Coupling that serves as a wing nut. The axle of the loose Pulley is extended and both ends are arranged to slide in a slot formed by two horizontal 3½" Strips spaced apart by Washers. Rotation of the wing nut causes the Threaded Rod and Pulley to move laterally, thereby adjusting the tension on the haulage rope. This detail, as well as the construction of the truck, etc., will be more clear on reference to the right-hand inset.

OUTSIDE FEEDER RAIL.—We do not altogether agree with your statement that an electric feeder rail placed outside the running rails, as on certain sections of the Southern Railway, would facilitate the working of points, etc. The gap in the "live" rail of the existing Hornby Points is too small to make an appreciable difference in the running of the train; moreover, an outside rail would have to be broken at the points in just the same way as a centre rail. (*Reply to C. A. Pullen, Beckenham*).

ELECTRIC LOCO COLLECTOR SHOE.—The change that you propose in the shape of the electric loco collector shoe has been noted and is being examined. We do not find that the present shoe catches in points, etc., but we would like to receive the opinions of other readers on this point. (*Reply to F. Morgan, Penarth*).

NEW ELECTRIC LOCOMOTIVES.—The question of the introduction of ordinary Hornby engines fitted with electric motors is engaging our attention at the present time. We note that you support the suggestions concerning the electrification of the No. 2 Tank Locomotives. (*Reply to T. A. Metcalf, Elstead, Surrey*).

TWO-SPEED GEAR FOR ENGINES.—We agree that a low speed gear is desirable for heavy goods trains and a high gear for express passenger traffic but many difficulties have to be overcome before a locomotive so regulated can be introduced. The matter will have careful attention however, and we shall be pleased to receive any further suggestions or opinions concerning it. (*Reply to A. Davies, Liverpool*).

IMPROVEMENTS TO METROPOLITAN TRAIN.—The provision of footboards and ventilators on the Metropolitan Train might add to its realism but would not improve its performance. However, we are keeping your suggestion before us. (*Reply to W. G. Lilly, Wallington*).

SADDLE-TANK LOCO.—Your proposed design for a saddle-tank shunting loco is very interesting but we fear it would be costly to manufacture and would fill no urgent requirement. (*Reply to K. Harrison, Bradford*).

SIGNAL OPERATION.—Strong pliable wire suitable for the control of signals is included in the Hornby Control Outfits. Does not this fulfil the functions of your proposed accessory? (*Reply to I. W. Scott, Westbury-on-Trym, near Bristol*).

LARGER TURNTABLE.—We shall consider the possibility of introducing a larger Turntable for use in connection with the No. 2 Locomotives. (*Reply to L. Hole, Bexhill-on-Sea, and C. Gilmour, Edinburgh*).

RUSTLESS RAILS.—As previously stated, Hornby track is not designed for permanent out-door working, and the introduction of rustless rails would, we fear, prove far too expensive. (*Reply to P. Falconer, Amberley, Glos.*)

WHISTLES ON LOCOMOTIVES.—The addition of whistles to Hornby Locomotives would serve no useful purpose and therefore we do not think the extra cost would be justified. (*Reply to P. Barkham, Redhill*).

BREAKDOWN ENGINE.—We note your suggestion concerning the introduction of a locomotive permanently connected to a breakdown crane. This would not be suitable for the Hornby system, however, as few enthusiasts would be willing to devote one of their locomotives to breakdown work only. (*Reply to E. Crilley, Kenilworth*).

(84)—Roller Bearings (Alternative Construction)–

(*Continued from page* 436)

spider-frame is built up from two Double Bent Strips 1 connected together by two Double Brackets 2. Only four Pulleys are used, and these are of the ½" "loose" type, journalled on Pivot Bolts secured to the outer ends of the four arms of the frame. Four Washers, arranged two on each side of the Pulley, are mounted on each of the Pivot Bolts that are attached to the Double Brackets 2, but in the case of the other two Pivot Bolts, two Washers are placed against the external side only of the Pulley.

The Axle Rod 3, which forms the axis of the model, is mounted in the boss of a Bush Wheel bolted in the centre of the Wheel Flange 4. The latter forms the fixed guide rail and the swivelling superstructure rests upon the ½" Pulleys in the same way as in Suggestion No. 83.

Results of
Meccano Model-Building Contests

By Frank Hornby

November Competition, Sections "A" and "C"

IN last month's Magazine I published the names of the prize-winners in Section "B" of the special model-building competition that was first announced in the "*M.M.*" for November 1926, and in summing-up the results I mentioned that we had experienced considerable difficulty in awarding the prizes. This difficulty was, if anything, intensified in the "A" and "C" Sections. Indeed, in many cases a great deal of thought was necessary in order to choose between the rival merits of the models submitted. However, I am able now to announce the final allocation of awards in these two sections. The results in Section "D" (Overseas) will be published next month.

Section "A" (Competitors over 16 years of age).

FIRST PRIZE (cheque to value £3-3s.): George W. Waples, 16, Rising Sun, Wallsend-on-Tyne, Northumberland. SECOND PRIZE (cheque to value £2-2s.): Richard S. Miller, 2, Wellington Road, Newark, Notts. THIRD PRIZE (cheque to value £1-1s.): L. W. Grey, 131, Kempton Road, East Ham, London, E.6.

SIX PRIZES, each of Meccano products to the value of half-a-guinea: W. Harbord, Normandy, near Guildford; H. H. Taylor, Lindley Moor, Huddersfield; W. C. Whitelow, Leeds; D. Hirst, Newmillerdam, near Wakefield; L. Hollyoak, Earlsdon, Coventry; N. S. and J. K. Wheatley, Claygate.

SPECIAL COMMENDATION (Certificates of Merit): W. Raybould (Jr.), Bloxwich, near Walsall; L. Noke, Birchfield, Birmingham; H. Bennett, Patricroft, Manchester; T. Carson, Motherwell, Lanarkshire; J. Wardle, Burton-on-Trent; J. Hunter Small, Brechen; J. Bartle, Low Moor, Bradford; E. H. Coole, Spalding; Geo. F. Moore, London, S.E.; D. Bowyer, Southampton; P. S. Smith, Crewe; G. Sellers, Southport.

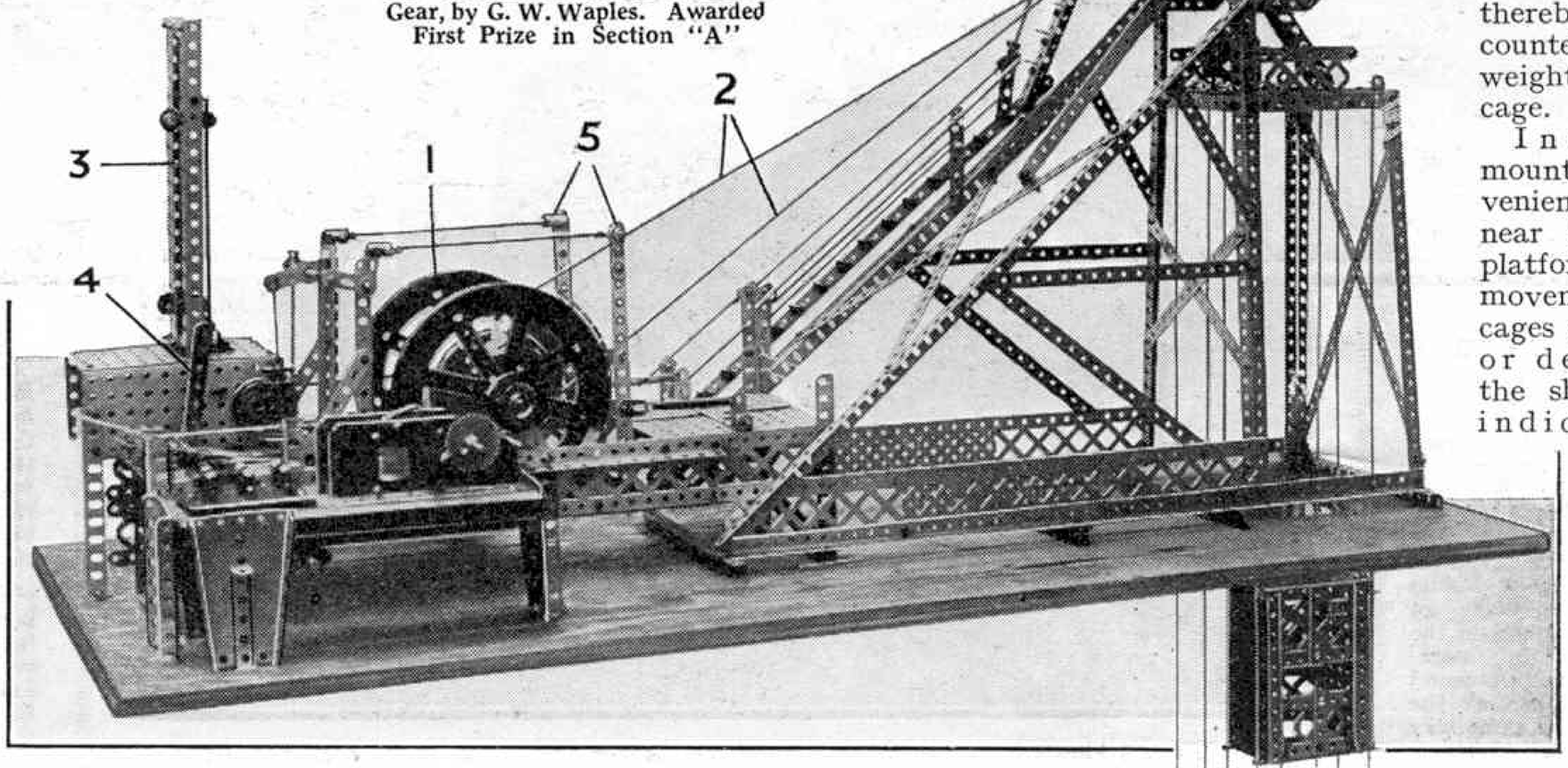
Section "C" (Competitors under 12 years of age).

FIRST PRIZE (Meccano products to value £2-2s.): C. Phillips, Blyth Vicarage, Rotherham. SECOND PRIZE (Meccano products to value £1-1s.): T. Andrade, 18, Keyes Road, Cricklewood, London, N.W.2. THIRD PRIZE (Meccano products to value 10/6): B. Faulds, Keddington Road, Louth, Lincs.

SIX PRIZES, each of Meccano products to the value of 7/6: Alex. Smith, Haddington; Albert Jones, London, N.W.1; K. Howes, Ilford; G. Mepstead, London, S.W.14; L. Stokes Roberts, Stratford-on-Avon; A. Luke, London, S.E.13.

SPECIAL COMMENDATION (Certificates of Merit): A. Baker, Keighley; D. Bell, Osmington, near Weymouth; G. Myers, Blackpool; W. Harper, Chesham Bois; D. C. Johnson, High Barnet; J. Gunstone, Beaconsfield; F. King, Witney; D. Broadbent, London, N.6; H. Taylor, Stanley, Liverpool; E. Joysey, London, E.17; J. Bompos Smith, West Didsbury, Manchester; J. Harriman, Long Eaton, Notts.; P. S. Macclean, Early, near Reading; P. Halliday, Camberley; S. Mark, Leith; J. W. Davis, St. Ishmael, Milford Haven; J. Fennerty, Skipton; H. Herbert, March, Cambs.; J. Firminger, London, S.E.25: A. J. Garratt, Aldershot.

An excellent model of a Pithead Gear, by G. W. Waples. Awarded First Prize in Section "A"



New Pithead Gear

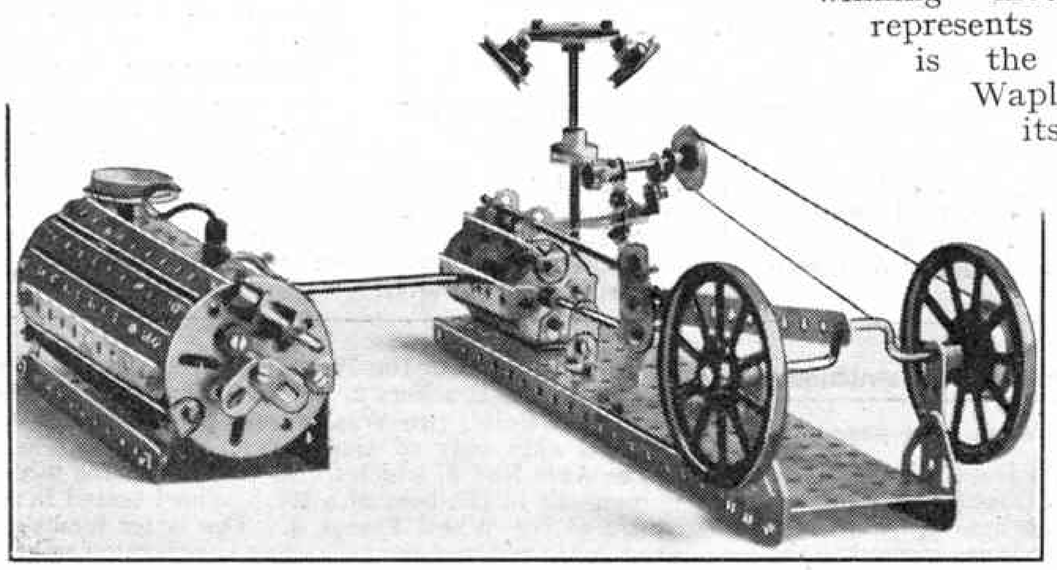
It will be seen from the larger illustration on this page that the First Prize-winning model in Section "A" represents a Pithead Gear. This is the work of George W. Waples, who was able to study its prototype from close range while at work in a coal mine. It is an excellent model and I can vouch for the fact that it works with the utmost smoothness and realism, for we have had a replica in operation in our Model Department.

The winding engine is driven by a 4-volt Electric Motor connected to the winding drum through an ordinary Meccano gear train. The drum (1) may be built up by bolting a series of Double Angle Strips between two 6″ Pulley Wheels or by bending a Braced Girder to circular form and securing it by means of Angle Brackets between the Pulleys. The two lift cages work simultaneously but in opposite directions, both hoisting cords (2) being attached to the single drum. The weight of the descending cage is thereby utilised to counterbalance the weight of the rising cage.

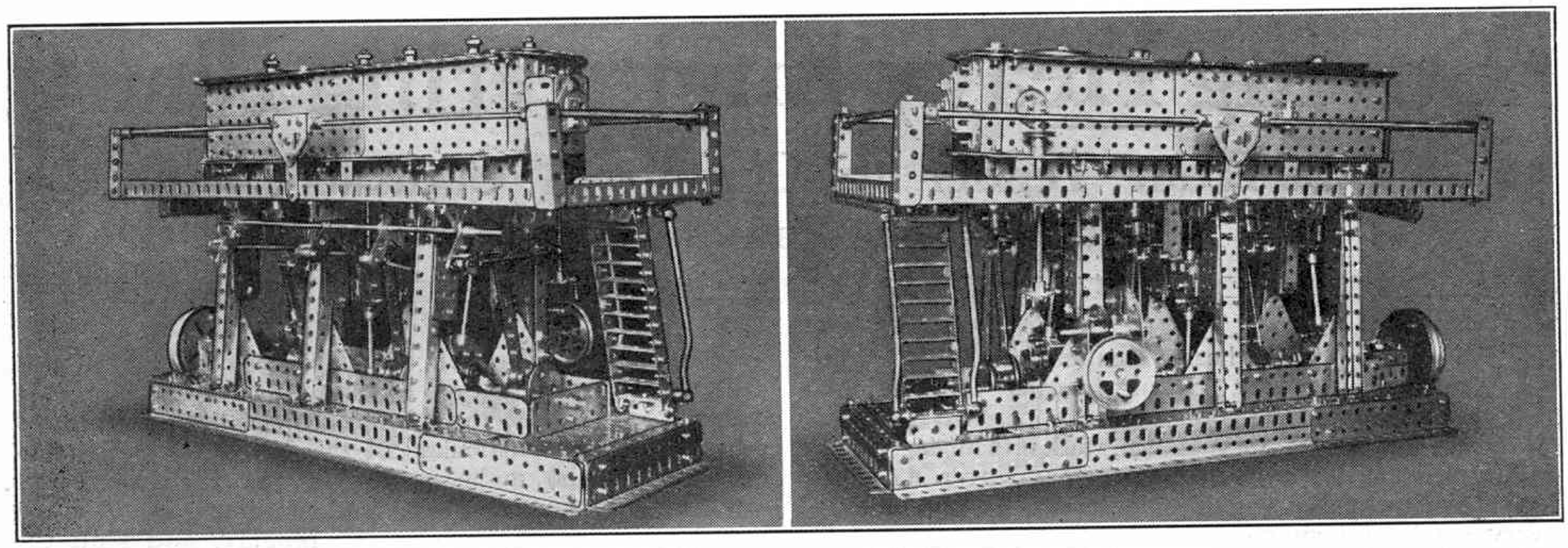
Indicators mounted in a convenient position near the driving platform show the movements of the cages as they rise or descend in the shaft. Each indicator consists of a Crank secured to a Threaded Boss that is caused to move up or down a vertical Threaded Rod in accordance with the movement of its respective cage. The Threaded Rod is rototed from the movement of the winding drum, to which it is connected by means of a reduction gear and Pinion and Contrate Wheel drive. The indicator Cranks slide in a vertical frame (3) and are so arranged as to prevent the rotation of the Threaded Bosses to which they are attached.

Arrangement of the Brakes

An ingenious braking system is provided. This is operated from a lever (4) situated on the driver's platform, and the brakes consist of semi-circular shoes ($5\frac{1}{2}$″ Strips bent to the curvature of the 6″ Pulleys) bolted to the levers (5), which are pivoted to the base plate and connected by horizontal Rods and Bell Cranks to the operating lever. The guide ropes for the cages are all attached at their lower ends to a base composed of two $5\frac{1}{2}$″ × $3\frac{1}{2}$″ Flat Plates bolted together by means of



Horizontal Steam Engine and Boiler. By Alex. Smith, age 11



Two views of Mr. Grey's model Triple-Expansion Marine Engine. Right : General view, with reversing control handle in foreground. Left : Rear view of model, showing eccentrics, reversing shaft, etc.

7½″ Strips and fitted on the underside with a heavy block of lead, the weight of which serves always to keep the guide ropes taut. This arrangement permits the "shaft" to be sunk to almost any depth, while the model remains easily portable.

A realistic effect will be obtained by enclosing the shaft in dark-coloured paper or cloth, thus giving the cages the appearance of descending into the earth. Much useful information may be gathered from the construction of a model of this kind, and its operation will provide endless amusement.

The model with which Richard Miller secures Second Prize in this section represents a horizontal log Band Saw. This is a very interesting model and comprises several notable movements and innovations. I hope to illustrate and describe it in a later issue of the Magazine.

A Fine Marine Engine

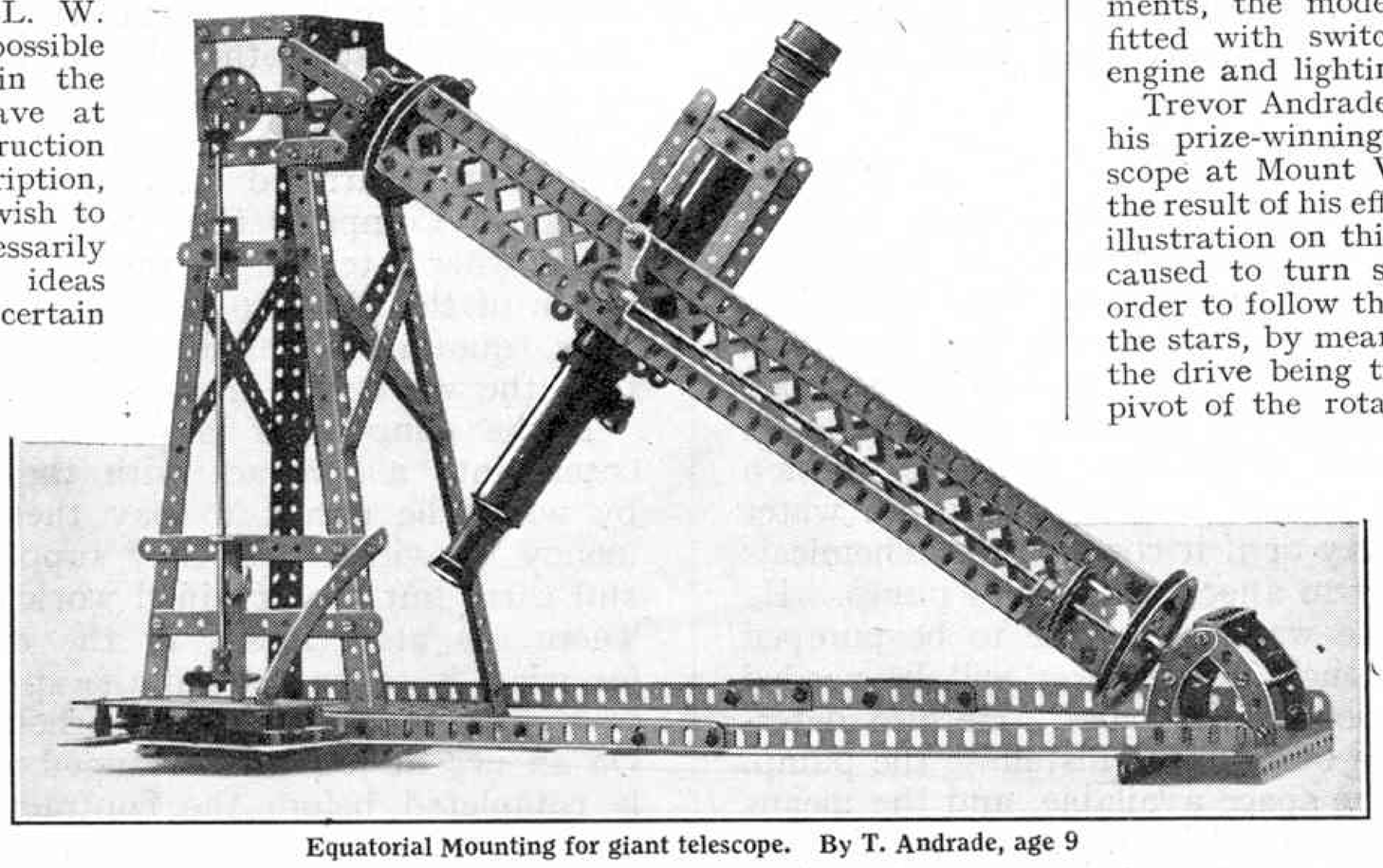
The splendid model of a triple-expansion Marine Engine shown in the accompanying illustrations secured Third Prize for L. W. Grey. It is, of course, impossible to describe in detail in the small space that I have at my disposal the construction of a model of this description, and those readers who wish to reproduce it must necessarily draw from their own ideas and experience to a certain extent. The following remarks, however, may serve to set Meccano boys on the right road to obtaining a realistic reproduction of a modern marine engine.

The steam chest is built up from 5½″ × 2½″ Flanged Plates, and the cylinder bushes and covers are represented as follows: low pressure cylinder, two 3″ Pulley Wheels (one at each end); intermediate cylinder, two Face Plates; high pressure cylinder, two 2″ Pulley Wheels. The crossheads and big-end bearings consist of Flat Trunnions secured by Double Brackets, with Fork Pieces to take the connecting rods and Eye Pieces to run on the guide bars. The latter, incidentally, are most realistic and efficient; they consist of 3½″ Strips secured by Double Brackets to 3½″ Flat Girders fastened to the side supporting columns.

Operation of the Valves

Each piston valve is operated by two opposed Eccentrics mounted on the crankshaft and having their arms pivotally connected to opposite ends of an expansion link. The latter consists of two 2½″ Curved Strips (large radius) arranged parallel to one another and connected together by means of Double Brackets. A 2½″ Strip bolted to these Double Brackets is fitted with an Eye Piece, and the latter is secured to a Threaded Boss that, in turn, is connected pivotally to a Fork Piece mounted on the lower end of the piston valve rod.

The reversing gear is operated as follows: a handwheel, composed of a 2″ Pulley and Threaded Pin (clearly shown in front view of engine), drives by means of a Worm and 57-teeth Gear Wheel a Face Plate to which a transverse Rod is pivotally attached by means of a Handrail Support. This transverse Rod is connected by a Crank to a shaft situated in the rear of the engine and this latter shaft is coupled by further Cranks to the various valve mechanisms (see rear view of model), the connections being effected by Rods pivoted at their outer ends to the Cranks by means of Fork Pieces and at their inner ends to the expansion links by Handrail Supports. Hence movement of the operating hand wheel, by rocking the links, alters the position of the Eye Pieces attached to the valve rods and thereby varies the movements of the valves.



Equatorial Mounting for giant telescope. By T. Andrade, age 9

Prizes in Section C

The high standard of merit noticeable throughout the entries in Section C is specially creditable in view of the fact that this Section was limited to competitors of not more than twelve years of age.

The First Prize goes to Master Phillips, aged 10, for a model touring car chassis that possesses a number of ingenious fittings that have not appeared in any previous motor car models. The gear box gives two speeds forward and reverse, and provides a straight-through drive on top gear. Amongst many other refinements, the model includes a dashboard fitted with switches for controlling the engine and lighting the head lamps.

Trevor Andrade chose as the subject for his prize-winning model the giant telescope at Mount Wilson Observatory, and the result of his efforts is shown in the lower illustration on this page. The telescope is caused to turn slowly upon its axis, in order to follow the apparent movement of the stars, by means of a Clockwork Motor, the drive being transmitted to the upper pivot of the rotating frame through the following gears: ½″ Pinion and 57-teeth Gear Wheel, ½″ Pinion and 1½″ Contrate Wheel, and Worm and 57-teeth Gear Wheel. The angle of the telescope itself may be adjusted on rotation of a hand wheel placed near the lower pivot of the frame.

Basil Faulds secured Third Prize with a model "Cake-Walk" driven by a Clockwork Motor and complete with roof, steps, pay box, and other realistic details. The smaller photograph on the preceding page is of a model steam engine plant, which secured a prize in this Section for Alexander Smith.

Buying Heavy Engineering Plant

From Tender to Completed Contract

By D. A. S. Williams, B.A. (Eng.); G.I. Mech. E.

THE purchase of heavy engineering plant and machinery is not by any means the straightforward job that some people apparently imagine it to be. One cannot, for instance, walk into an engineer's office and ask for a steam engine, hand over the cash and take away the engine in a lorry! If it is only a very small and simple piece of machinery that is required it is possible that the works may have a suitable one in stock, but if the machine is at all large or complicated it will have to be specially made so that it will answer exactly the particular requirements of the purchaser.

In order to survey the different operations that have to be carried out to fulfil a single order, let us take a concrete example. Say a mine-owner wants to instal another pump for keeping his mine clear of water, because the pumps that he already has are unable to cope with the extra water coming into his new workings. Perhaps he already has working two "*Splashem*" pumps that seem very reliable and efficient in operation, and so he writes to the Splashem Pump Company to say that he wants another.

Photo courtesy [*Sir William Arrol & Co. Ltd.*

Drawing Office of a Large Engineering Works

Purchasing a Large Power Pump

The company then send a representative to have a look at the mine, in order to ascertain just what work the pump is required to do and under what conditions it will have to do it. This man will find out from the mine-owner how much water has to be pumped per hour—the new pump will probably be larger than is needed at the moment, to allow for further expansion of the workings—and he will have a look at the water to see if it is very gritty or if it contains any chemicals or is in any way likely to affect the type of pump. He measures how high the water will have to be pumped and works out how much extra power will be needed to overcome the friction in the pipes. He also determines what will be the best way of installing the pump, taking into account the space available, and the means by which the pump will be driven. In short, his task is the responsible one of observing and taking into consideration every factor that might affect the job in the slightest degree.

The firm's representative then makes out a full report, which is sent in to the Technical Department.

After full consideration the department finally decide that one particular type of pump, out of all those that they make, will do the job the best. They immediately hand over the particulars of the job to the Design Department, who make a note of any alterations that will be necessary to their standard design, sketch them roughly, and send the whole lot of drawings, together with a "List of Quantities," to the Estimating Department.

Preparing the Tender

This "List of Quantities" shows just how much metal there is in each casting, the number of bolts, nuts, studs, etc., in the job, and their sizes, and all other particulars to enable the estimating department to work out how much the material of the pump will cost. In addition to this they estimate, from their experience with similar pumps made before, what it will cost them in wages for the various men who will work on the job. They also add a certain amount for profit and for "overhead charges," the latter covering wear and tear of machinery, rent of the works, office expenses, and a whole host of other charges that cannot be assigned to any one particular job.

By adding up all these items the probable cost of the pump is arrived at, and the management of the Splashem Company then prepare and submit to the mine-owner a tender for the work, giving a full specification of the plant to be supplied and the work to be done, quoting a definite price, and stating at what time the work will be finished.

If the mine-owner is satisfied with this tender, he enters into a contract with the Splashem Company, by which he agrees to pay them the stated sum of money, provided that they supply the specified plant and carry out the specified work in the specified time. There are also clauses in the contract that provide for what is to be done if the specification is departed from, or if the work is not finished in the contract time. On an urgent job it is arranged also that, if the work is completed before the contract time, the customer pays a bonus for every day gained.

In the meantime, while the contract is being negotiated, the Splashem Company's drawing office have been busy adapting their standard design to suit the exact requirements of the case, so that, by the time the contract is completed, they will have their designs well

on the way towards completion.

The Contract Signed

As soon as the firm get the contract signed, they give the job an order number—usually all orders are numbered consecutively whether they are large or small—and this order number is then used as a reference right through the works. The office make out a list showing every single part that goes to make the complete pump, together with the size and a reference number for each, and a copy of this list is sent out to every foreman who will have anything to do with the job.

When the drawings are finished, they are carefully checked over by a senior draughtsman, or by a special checker who does nothing else, and they then go to have tracings made from them. After the tracings are finished, the drawings go back to the drawing office where they are carefully stored, and the tracings go to the "blue room," where blue-prints are made from them, one set for each department of the works. It is not until all this has been done that any work on the actual manufacture of the pump can be started.

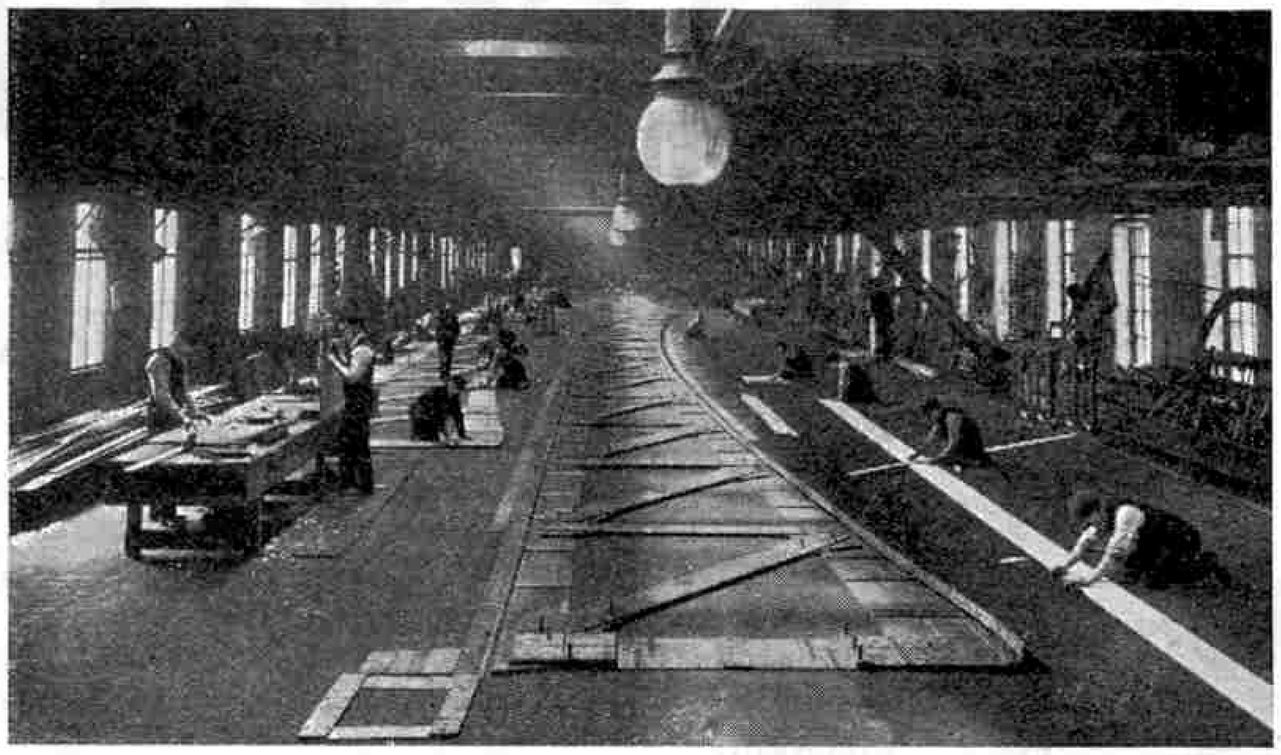


Photo courtesy [*Sir William Arrol & Co. Ltd.*

Template Shop, where the jobs are laid out to full scale

Making the Castings

The pattern-store keeper, when he receives the drawings, looks at the list of parts on each and if there are any parts of which patterns already exist—which is probably the case if the job is more or less standard—he takes these patterns out of store and sends them to the pattern shop. There they are altered if necessary, new patterns are made when required, and the finished patterns are then carefully checked over before being sent to the foundry.

The patterns go to the foundry itself, to the moulders, who use them to form the mould out of foundry-sand, but in order to save time the core-boxes usually go to a separate core-shop where they are rammed up, and the finished cores are sent into the foundry. Thus when the moulder has finished with the main pattern he has only to put the finished cores into place to have a complete mould, which is checked over to see that none of the cores are out of position. The mould is then made ready and the molten metal poured into it, afterwards being left to solidify and cool.

When the mould is cool, the sand is knocked away and the casting is taken to the fettling shop, where all the "leads" and "flash-metal" are knocked and chipped off, and the core-sand is poked out from inside. If the job is done really well, the castings are then "sandblasted" with chilled steel shot blown at them by a jet of compressed air, to clean the sand out of the pores, and they are also "pickled"—that is, they are soaked in a chemical that dissolves the sand out of them without affecting the metal in any way. The finished castings are then sent to the machine-shop store.

In the meantime the smiths have been making all the necessary forgings, such as connecting rods and crankshafts, which are also sent into store until the castings are ready.

Machine-Shop Operations

When all the rough materials for the job have been collected, they are inspected for flaws and, if passed, are let out to the machine-shop, where all the necessary planing, boring, drilling, milling, and turning is done. Previously, however, they go to the marking-off tables, where the centres of all bolt holes and of all borings and turnings, together with the position of all faces, are carefully marked, so that when the part is completely machined it will be exactly to the dimensions shown on the drawings. In order to ensure that this will be so, very accurate gauges are used by the workmen and the dimensions are constantly checked.

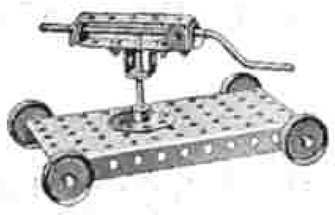
While all this has been going on, the buying department of the firm have been ordering the parts that will be wanted from outside, such as lubricators, special gland packings and piston-rings, so that, by the time the machining operations are finished, all the parts needed to make the pump will be available. Thus, with the exception of bolts, nuts, studs, and similar small parts, which are drawn from the stores as required, all the parts can be handed over in a lump to the erecting-shop.

Small built-up parts such as throttle valves, governors and so on, go to the detail fitters, who clean up and assemble them ready for the erectors. The latter in the meantime have been proceeding with the work of putting the main parts of the pump together, and fitting bearings and lining up shafting. After the pump has been erected, it has fixed to it its identification plate, which shows its number, size, power, and other particulars, and then it is sent to the test-house.

Testing the Assembled Machine

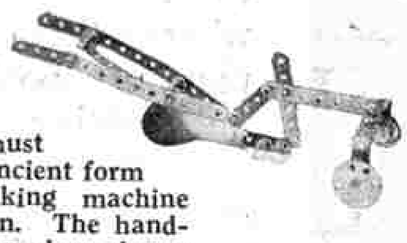
If it were a very big job, the machine would have to be taken to pieces and re-erected on the test-bed, but our mine pump probably would be carried easily by one of the overhead travelling cranes, some of which can lift thirty tons or more. In the test-house the pump would be coupled up to an electric motor, if that were how it would ultimately be driven, or, if it were to be steam-driven, it would be coupled to the test-house boiler. A suction pipe would be fitted to draw from a big tank under the floor, and a discharge pipe, fitted with a throttle valve and pressure gauge, would return the water to the same tank.

After preliminary trials to see that it is working properly, the official test is made, at which the customer is usually represented so that he can see for himself that the pump is really capable of performing its specified duty. As it would not be convenient to put up a vertical pipe-line of several hundred (*Continued on page 453*)



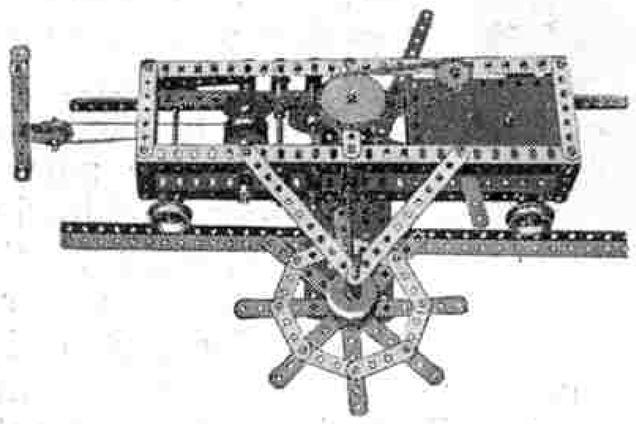
ROCK DRILL

This is a No. 0 Outfit model of a typical pneumatic rock drill, of the type used in mining and other work.



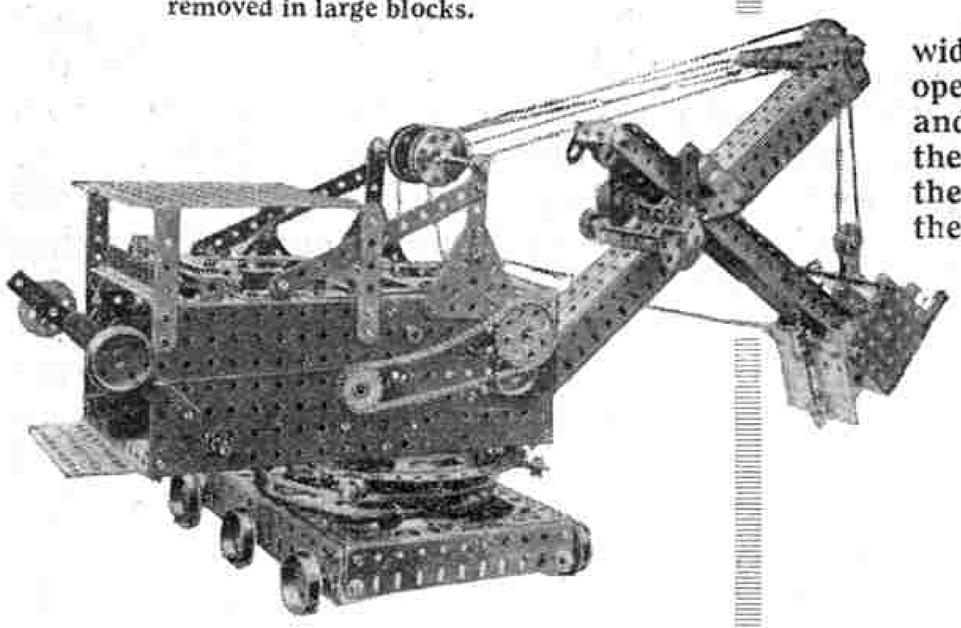
PLOUGH

The plough must be the most ancient form of earth-breaking machine known to man. The hand-manipulated type here shown is fast disappearing from our countryside.



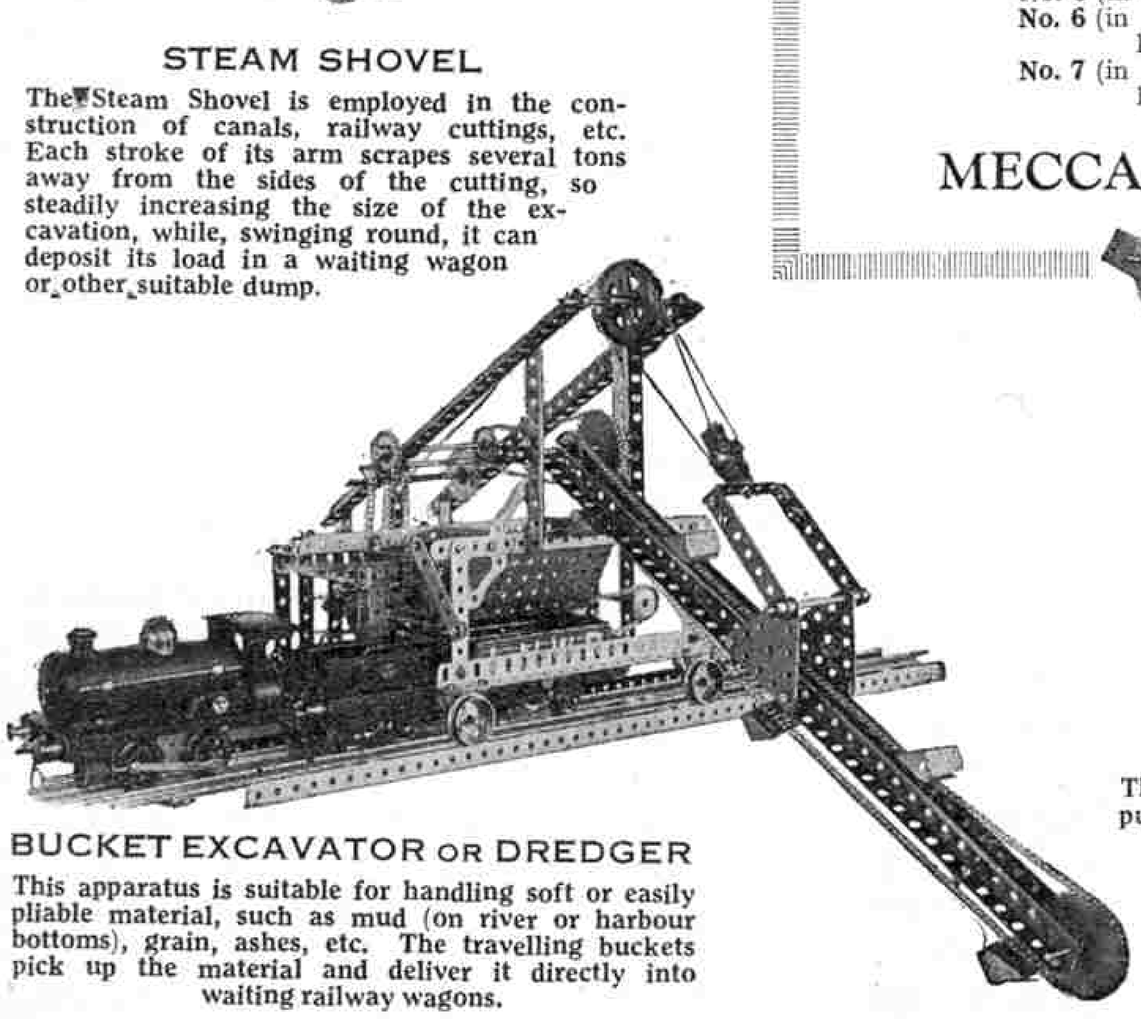
COAL CUTTER

This apparatus, by hauling on a rope, pulls itself along in a direction parallel to the coal-face, while its revolving cutters slice into the coal, which may afterwards be removed in large blocks.



STEAM SHOVEL

The Steam Shovel is employed in the construction of canals, railway cuttings, etc. Each stroke of its arm scrapes several tons away from the sides of the cutting, so steadily increasing the size of the excavation, while, swinging round, it can deposit its load in a waiting wagon or other suitable dump.



BUCKET EXCAVATOR OR DREDGER

This apparatus is suitable for handling soft or easily pliable material, such as mud (on river or harbour bottoms), grain, ashes, etc. The travelling buckets pick up the material and deliver it directly into waiting railway wagons.

THE NEW MECCANO

Examples of Model Construction:

2. CUTTING AND DIGGING MACHINES

TRANSPORT, Irrigation and Mining are three branches of industry responsible for the introduction of many wonderful machines by which channels are cut, tunnels bored, small hills levelled, and rivers deepened. The constant demand for greater efficiency and increased speed at which such engineering works may be carried out, has resulted in the construction of giant engines that are marvels of power and precision.

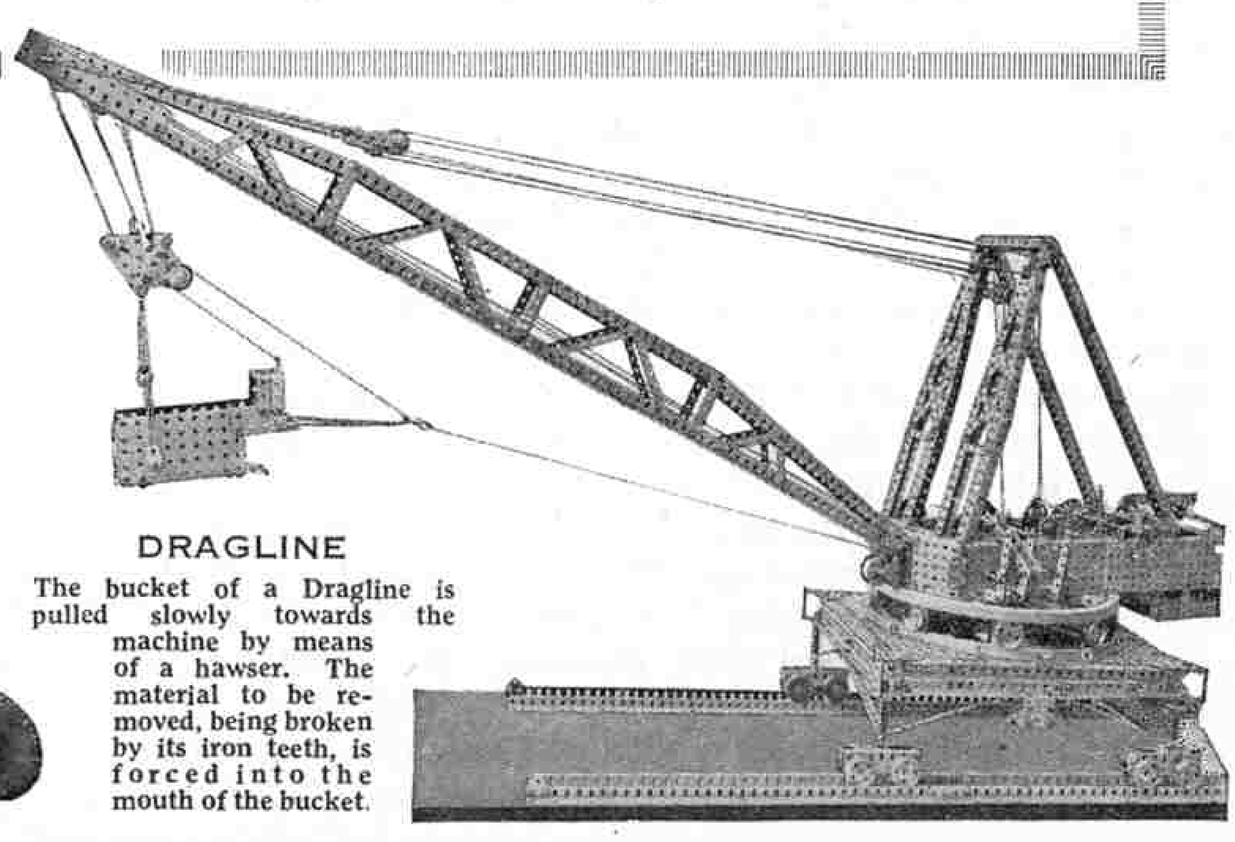
Innumerable examples might be quoted—such as the Panama and Suez Canals and the Simplon Tunnel—as typifying the extent to which man has been able to force a passage through the most difficult obstacles, with the aid of mechanical power. The immensity of these works leaves one with the impression that they must be the outcome of the slow processes of nature, rather than the result of a few short years of man's intrepid effort.

The Meccano models shown accurately reproduce the apparatus now widely in use, and are most fascinating to construct and to put into operation. Excellent fun can be obtained with the Dredger, Steam Shovel, and Dragline by employing a pile of silver-sand, or gravel, beads, etc., as the material to be handled. For this purpose the shovels, or buckets, of the last two models should be lined with sheets of cardboard, to prevent their contents escaping.

MECCANO PRICES

COMPLETE OUTFITS		ACCESSORY OUTFITS	
No. 00	3/6	No. 00a	1/6
No. 0	5/–	No. 0a	4/–
No. 1	8/6	No. 1a	7/6
No. 2	15/–	No. 2a	8/6
No. 3	22/6	No. 3a	18/6
No. 4	40/–	No. 4a	15/–
No. 5 (in well-made carton)	55/–	No. 5a (in well-made carton)	50/–
No. 5 (in superior oak cabinet with lock and key)	85/–	No. 5a (in superior oak cabinet with lock and key)	80/–
No. 6 (in well-made carton)	105/–	No. 6a (in superior oak cabinet with lock and key)	210/–
No. 6 (in superior oak cabinet with lock and key)	140/–		
No. 7 (in superior oak cabinet with lock and key)	370/–		

MECCANO LTD., Binns Road, LIVERPOOL



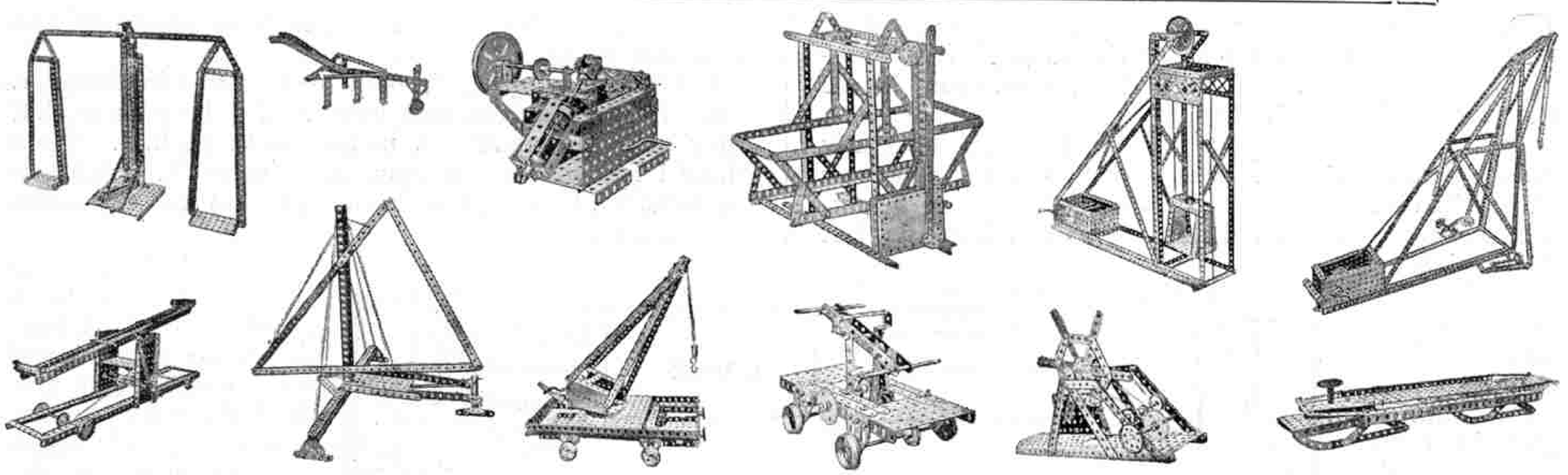
DRAGLINE

The bucket of a Dragline is pulled slowly towards the machine by means of a hawser. The material to be removed, being broken by its iron teeth, is forced into the mouth of the bucket.

Special "No. 3 Outfit"

Model-Building Competition

Thirty-six Splendid Prizes to be Won



CONTINUING our 1927 series of Meccano "Outfit" Model-building Competitions we announce this month the new "No. 3" contest, in which prizes are offered for models built entirely from a No. 3 Meccano Outfit. Models comprising parts that do not appear in that Outfit will be disqualified, but it is not necessary to use all the parts contained in the Outfit. Those boys who possess larger sets need not abstain from competing, for their entries are eligible providing they use only parts that may be found in the No. 3 Outfit. An up-to-date list of these is given below and competitors should check their models by means of the list before entering the contest.

LIST OF PRIZES

Prizes will be awarded for the best entries FROM EACH SECTION as follows:—

FIRST PRIZE: Meccano products to the value of £3-3s.

SECOND PRIZE: Meccano products to the value of £2-2s.

THIRD PRIZE: Meccano products to the value of £1-1s.

SIX PRIZES, each consisting of Meccano products to the value of 10/6.

Four Different Sections

Prizes will be awarded for the models that the judges decide to be the best received, after due consideration has been given to the originality of thought and constructive skill displayed in every entry. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts. Any type of model may be submitted provided that it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following sections: Section A, for competitors over 16 years of age. Section B, for competitors under 16 and over 12 years of age. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain.

Closing Date for Sections A, B, and C: 30th June. Section D: 30th September, 1927.

Important Instructions

Readers should send in clear photographs or good drawings of their models together with any explanations that may be necessary.

The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition (No. 3) and the Section in which the model is entered. Envelopes should be addressed "No. 3" Competition, Meccano Ltd., Binns Road, Liverpool.

Actual models should not be sent. A clear photograph or drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd.

Contents of Outfit No. 3

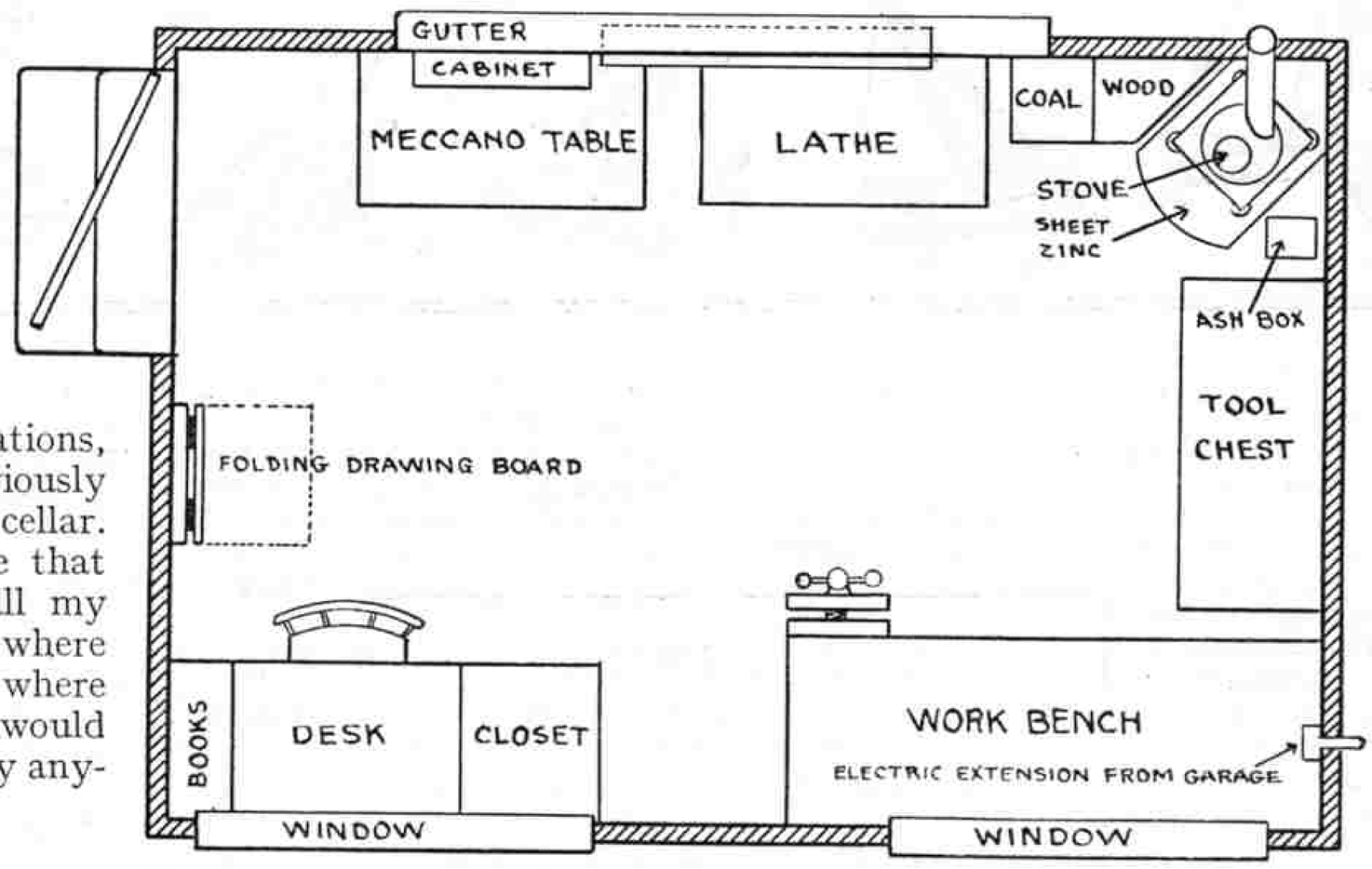
10	of No.	1	4	of No.	16	1	of No.	32	2	of No.	52	2	of No.	111
18	" "	2	2	" "	17	1	" "	34	3	" "	53	6	" "	111c
6	" "	3	2	" "	18A	12	" "	35	2	" "	54	1	" "	115
2	" "	4	2	" "	19	1	" "	36	1	" "	56	1	" "	116
12	" "	5	1	" "	19B	84	" "	37	1	" "	57	4	" "	125
2	" "	6A	4	" "	20	6	" "	37A	4	" "	59	4	" "	126A
8	" "	8	1	" "	21	12	" "	38	2	" "	62	1	" "	134
8	" "	10	4	" "	22	3	" "	40	1	" "	63	1	" "	147A
4	" "	11	2	" "	22A	1	" "	44	4	" "	90	1	" "	147B
14	" "	12	1	" "	23	1	" "	45	4	" "	90A	1	" "	148
3	" "	12A	1	" "	24	1	" "	46	1	" "	98			
2	" "	15	2	" "	26	10	" "	48A	2	" "	99			
3	" "	15A	1	" "	27A	2	" "	48B	2	" "	100			

How I Built My Own Workshop

In this article Wilson G. Walters, a "*M.M.*" reader who lives in the United States, describes how he built his own workshop. I feel sure such a cosy and well-planned workshop as this seems to be, will appeal to all readers of the "*M.M.*"—*Editor.*

ONE day about four years ago I was asked by an interested friend what "the height of my ambition" was. After thinking a moment I said that it was about eight feet!

By this rather cryptic remark I meant that my greatest wish was to have a workshop of my own, one that I had already planned to be eight feet in height. I had always been an enthusiastic user of Meccano, but now my interest for "things mechanical" had spread out to other fields also, and I thought I had reached the stage where I needed a place of my own to carry on my operations, which had previously been done in the cellar. I wanted a place that I could really call my own—some place where I could work and where my experiments would not be ridiculed by anyone.



Floor Plan of Workshop

Dad Consents

I feel sure that every Meccano boy would like to own a workshop but he thinks it's beyond his means. Mine cost me about £10 and certainly £10 can't be said to be beyond the means of a boy who is capable of earning and saving his money. When I had thought over the "great idea" I resolved to stop spending my money on sweets, pictures, and such things and save it for the better things in life.

I scarcely know how I'd survive without my workshop, for I spend a good deal of my time there. Although the materials in it are probably not worth even £10 I doubt whether I would part with it for ten times that sum!

In the Autumn of 1922 I started planning, making some rough scale drawings on old wrapping paper, with hopes of convincing my father of my necessity. Father, of course, rejected the idea at the first hint, but I soon talked him into it so that he agreed—but wouldn't admit it!

Now that this important part of the business was over I set to work in earnest. The next week when he came home I already had the skeleton up, so that if he had objected it wouldn't have done much good for it would have been too late! But as it happened he didn't object at all!

As soon as I had definitely made up my mind regarding the details of the workshop—which was not an easy matter—I carefully prepared the final drawings and then was ready for action.

I started by digging six holes about a foot in diameter. Into these I sunk two foot lengths of cedar post so that they extended about six inches above ground. Upon these I planned to construct the framework, which was to consist of two main beams (4×4's) braced across with 2×4's.

After I had completed the framework I laid the floor. I built the window sills and door frame right into the framework, so that it was then only necessary to nail on the siding, which has to be put on with care—as well as with nails! All the joints have to be made to fit tight.

The roof slants about a foot, the width being 8′, and is covered with shingles or tar paper, whichever one prefers.

I secured some second-hand windows, which I found to be just the thing, and mounted these in grooves made by strips of wood so that they would slide open.

The door I made myself from tongued and grooved boards and braced them from the inside. I also made a door step just to make it seem "like home," but this isn't really necessary.

Making the Workshop Weather-proof

As it turned out, the workshop was not quite weather proof, so I decided that a layer of shingles would help it a lot. I went at it and although this didn't prove to be a very interesting job, it sure made my "home" good and snug. I happened to be lucky in getting a lot of shingles that had just been taken from the house and were still in a fairly solid condition. I have been glad since that I took this extra trouble, for a workshop that lets in rain is no use to anybody.

Later I found some old bricks, and I thought they would look good around the corners to hide the posts. This also was a hard job but the result was worth it.

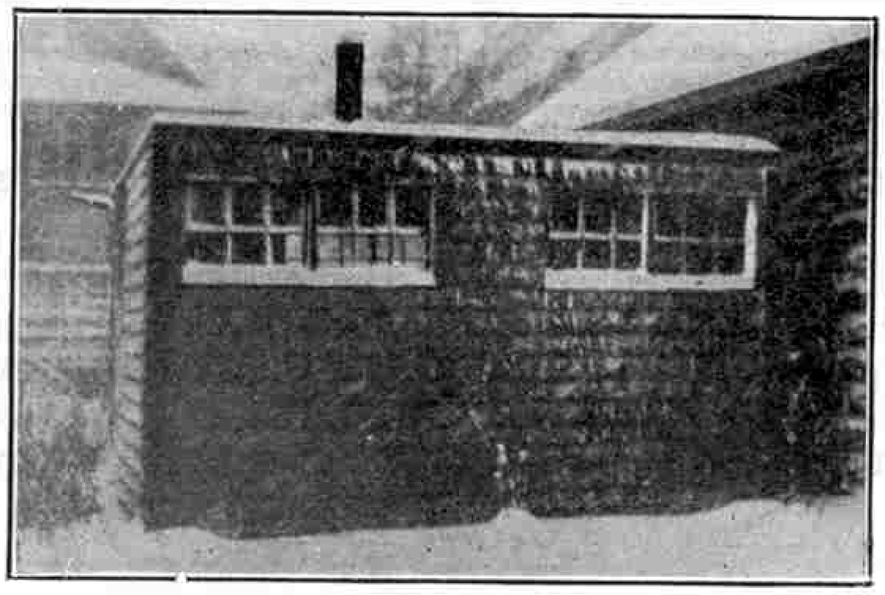
When the snow came, I got some lengths of board and fastened them so as to close up the space between the ground and the rafters to keep the cold air out. Later I picked out of a pile of old gutter pipes a piece long enough to extend almost the full length of the roof and fastened this to the edge of the roof, having a drain pipe (also from the junk heap) run down from it to the ground.

The Interior Arrangement

Now to go to the interior, which I think is the most interesting part of my shop.

The first addition in the way of furnishings was of course my work bench. This I made from two large heavy planks, solidly supported on legs, made from the remnants of the wood of the shop.

The next part of the equipment to be made was a desk, as I didn't want my shop to be only a place to work in but one where I could also have my general headquarters. I made this desk from left-over scraps also, making one large centre drawer and two others at the side fashioned from old boxes, I borrowed (?) an old chair from the house to go with the desk and also made a small shelf for the few books that I possess.



Outside View of Workshop

The Meccano Table

Next in order was my Meccano table, made so as to fold down against the wall when I wasn't using it, for there was not too much room in my shop, as you can readily see from the diagram.

For my Meccano parts I made a small cabinet in which I conveniently placed the various parts, then fastened the cabinet to the wall right above the table. By this time my shop was too cold to work in, so with some money I received at Christmas I bought a small stove from a second-hand dealer (for about 15/–) and placed this in the corner on a sheet of zinc and surrounded it with a large piece of old tin—you see I wasn't insured and didn't want to burn down my "home" right away! The stove pipe was easily put up, and extends well above the roof to provide a good draft.

With this additional equipment came the coal bin, made from an old box; the wood box, made from a large piece of tin; and then the "ash pan"—an oil tin with wooden handles fastened to the sides.

A drawing board of some kind seemed necessary, so I found a large board in the cellar and hinged it to a strip fastened to the wall so that it also could swing down out of the way. My lathe is still in the making but I shall have it ready before long. The positions of all these things are clearly shown in the accompanying drawing.

Lighting the Workshop

Some means of lighting was also essential, as the candles and paraffin lamps that I had previously used were not only impractical but also dangerous. At this time the garage, to which my workshop was attached, was being wired so I asked Dad to have an extension run over to my workshop, and this he—very kindly!—did.

The latest and most novel addition to the equipment of my shop is a signal arrangement whereby I can be called to the house when wanted. I wired a small bell to a dry cell in the workshop and then ran two wires to a push button in the house. A code of signals was decided upon—two rings mean "Dinner is ready," three rings mean "You're wanted on the telephone," etc.

What the Shop Cost

Now as to the size, cost, materials, etc. In the case of my shop, the size is 12 ft. in length, 8 ft. in width and 8 ft. in height. It is plenty large enough for most things that I want to do, but of course it could be made any size desired.

I obtained all the materials, including wood, windows, tar-paper for roof, nails and all other hardware, for not more than £10. This is quite a small sum compared with the amounts most fellows spend thoughtlessly, and I dare say I've had more real fun than they have had and I still have something to show for my money.

The height of my ambition has now, of course, grown from the initial 8 ft. to a height that can't be measured in feet but only in accomplishments, etc.

As a result of my working in my shop and applying those general mechanical laws that I first learned through my contact with Meccano, I now have several inventions. I hope soon to have patented these and having marketed them, to make them pay for my shop many times over!

A 62-Ton Steam Derrick Crane—

(*Continued from page* 411)

The main hoisting motion is by double-purchase spur gearing, and two speeds are obtainable, the change being effected by clutches sliding on square shafts. The barrel is secured on a square shaft, and the grooves in the barrel are machine cut to suit steel wire rope—eight falls—and suitable for a lift of 50 ft. below and 25 ft. above rail level. The block with ramshorn hook swivels on ball bearings and has hand turning gear.

A powerful screw brake and two oil brakes are fitted on the second motion shaft. The oil brake cylinders are 8 in. in diameter and 12 in. stroke, the connecting-rods engaging on the second shaft, on which suitable cranks are provided. These brakes are controlled by means of a lever, screw, and hand wheel from the driving platform. The auxiliary hoisting motion is designed to lift a load of 10 tons on a single rope by spur gearing from the second motion travelling shaft; the machine-grooved barrel running loose on the shaft and being driven by a coil clutch put in motion by a lever. The clutch can also be controlled by a hand wheel and screw. This motion is provided with a brake operated by a hand wheel and screw, and is designed for grabbing work.

The derricking motion has two safety catches and a locking device to prevent the jib getting out of control. A special "tell-tale" device is fitted so that the driver can see that the clutch is engaged. The travelling motion is operated by machine-cut bevel and spur gearing placed in motion by means of a steel clutch and lever. The clutch works on a square shaft, and a screw brake is provided, being controlled by a hand wheel from the driving platform.

The revolving motion is worked by means of a pair of engines under the footplate, through spur and bevel gearing down to a large external wheel. It is controlled by a foot brake. The driver's platform is placed on the side of the mast, and all the levers and hand wheels are arranged so that the driver can see his load.

All the gearing is of steel, the travelling gear being machine cut. The axle-boxes are provided with oil wells, fitted with weighted rollers, and grease cups are fitted to each bearing and to all the main shafts.

The boiler is secured to the mast behind the pivoting centre, so that its weight helps to counterbalance the weight of the jib and its load. Its position, as well as that of the driver's platform, is clearly shown in the illustrations.

This large derrick crane is particularly suited for reproduction as a Meccano model. We shall announce next month a special Competition, with valuable prizes, for the best Meccano model of this crane.

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Whittington Castle

One of the little known castles of Shropshire is that at Whittington, about two miles from Oswestry, and any "*M.M.*" reader who may find himself in the vicinity should make a point of visiting it if possible. It makes a very fine photographic subject and is situated so close to the main road that the latter forms a margin to the moat.

Whittington Castle is said to have been first built by Ynyr ap Cadfarch, an English baron, in the year 843, and at one time it was held by Sir Fulke Fitz-Warine, a Lord Marcher under King Richard. It was the business of the Lords Marcher to control and defend the borderland, Saxon Mercia, from the Welsh.

The story goes that Sir Fulke Fitz-Warine was unwise enough to win a game of chess that he was playing with Prince John. The Prince in anger struck the knight with the chess-board, scattering the pieces in all directions, and Fitz-Warine retaliated by slapping the Prince on the cheek. Prince John did not forget, and when he came to the throne Fitz-Warine fled to France and Morice, a favourite of King John, took over the castle. Morice was eventually murdered, it is said at the instigation of Fitz-Warine, and the latter afterwards succeeded in obtaining the King's pardon and Whittington Castle.

Of the original structure only the gateway, flanked by its two embattled towers, now converted into cottages, remains in a fair state of preservation.

Access to the castle is gained from the road by a narrow pathway that runs rather steeply over a small bridge across the moat to the great doors. Passing through these we may enter what was once the courtyard, now a piece of broken ground with shady trees.

A beautiful feature of this charming castle is the moat, in whose placid depths are mirrored the aged grey walls and the little bridge from which hangs many a wild plant. Over the still surface of the water kingfishers in blue and gold may be seen to hover momentarily before disappearing into the vegetation that fringes its margin.

ERIC J. HELSBY (Ince).

A clever pen and ink drawing, by Eric Helsby, to illustrate the accompanying article

My First Aeroplane Flight

A short time ago I made my first flight in an aeroplane. The machine was an "Avro" with a 9-cylinder Le Rhone rotary engine of 150 h.p., and when I arrived at the flying ground a mechanic was filling the fuel tanks. Shortly afterwards I was told to get into the cockpit and I clambered in and made myself comfortable.

A mechanic at the propeller called out "Contact!"

"Contact!" replied the pilot, at the same time pressing a small switch.

The mechanic swung down the propeller blade and immediately the engine burst into song; a cloud of dust was raised and the grass lay flat. Then the roar of the engine increased in volume and we "taxied" over the ground. After running across the field for about 90 yards, we left the ground and for a while climbed up steeply. Then we flew for a time on an even keel and I gazed eagerly at the fascinating panorama below. The River Trent looked like a ribbon of shining silver zig-zagging through the green of the countryside.

Shortly afterwards I noticed two other aeroplanes much higher up than we were and perhaps four miles away. By "zooming" three times we got on a level with the other machines, and when about half a mile from them we banked and flew with them for a time, during which period I had a wonderful view of them. I had often seen a similar sight in cinema pictures, but this was the "real thing" and much more thrilling.

Presently we left the other machines and flew over the town and so back to the flying ground. At the right moment the pilot shut off his engine and we glided down with every strut and wire whistling. Rapid as was our descent, we landed with scarcely a bump, and thus ended my first flight.

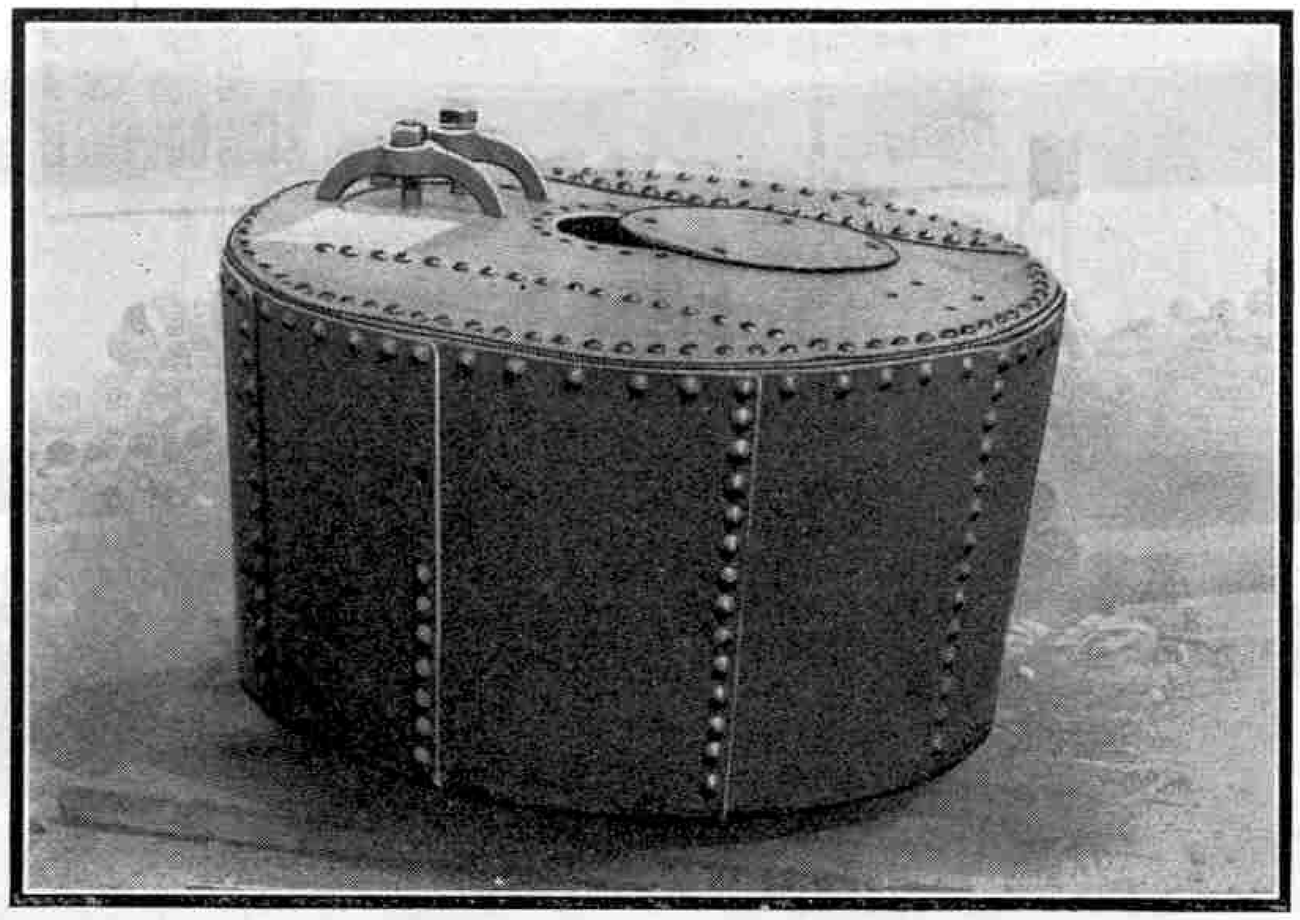
A new experience of this kind is always a memorable event and in my case it was intensified by a sad event that occurred not long afterwards. The aeroplane in which I had flown crashed at Great Bookham, Surrey, and Capt. R. H. Leavey, the pilot who took me up, and his mechanic, Mr. Keene, were both killed.

E. R. ELLIOTT (Burton-on-Trent).

A Link with Trevithick

An interesting link with Richard Trevithick, the builder of the first steam engine to run on a railway, has just been passed on to the South Kensington Museum. This is a boiler that was built by Trevithick at Hayle, Cornwall, in 1812, for use with a threshing machine, and is shown in the accompanying photograph.

About this time Trevithick gave a great deal of attention to agricultural machinery and produced in succession a steam threshing machine and a steam plough. In a letter written in 1812 to the Board of Agriculture he stated his confident belief that every branch of agriculture could be carried on by steam, and expressed the view that such a use of the steam engine would "double the population of the kingdom and make our markets the cheapest in the world."



An interesting link with the past—a boiler built by Trevithick

The boiler, which has been lying for a long time in an old plantation, stands just over 3 ft. in height. It is about 5 ft. in diameter at the top and about 4½ ft. at the bottom. It is strongly constructed but, as careful examination of the photograph will show, the joints and seams are very crude.

W. TERRILL (Hayle).

A Visit to a Gasworks

Owing to the enterprise of our chemistry master, together with the kindness of the Douglas Light Company (Isle of Man), the form of which I was a member were privileged to visit the Gasworks.

First of all we visited the furnace house, which contained several huge furnaces. We were given the opportunity of taking the temperature of one of these heat-producing monsters, not with a thermometer, but with an electrical apparatus somewhat similar in appearance to a pair of binoculars. The fireman opened the furnace door, the apparatus was applied to the eyes and the fire viewed through it. All there was to be seen, however, was what appeared to be a red-hot piece of wire. This wire, by adjustment of a knob, gradually became white, and when it was quite white the temperature was ascertained from a gauge on the apparatus.

We then went on to the next house containing the ovens in which the coal from which the gas was to be produced was heated by the furnaces immediately below. There we witnessed a most thrilling—and very smoky—spectacle in the opening of the oven doors in order to rid them of their white-hot load after a certain pre-determined period had elapsed. The doors were opened, a traversible metal shield was placed in front of them to prevent anything going astray, and then the man in charge proceeded to rake out the white-hot mass. This then fell into a conveyor let into the floor, which transported it to cooler regions.

After the ovens had been emptied from the front, the reverse process took place from the back. On moving round to the other side we found a splendid electric coal conveyor and chute, which moved gracefully up and down behind the long row of ovens. After seizing its load the conveyor responded to the touch of a lever and moved to a suitable position behind one of the ovens. Another touch of a lever caused the oven door to open, and yet another control movement resulted in the shooting into the oven of the exact amount of coal required to feed it. Finally, this obedient machine closed the oven door.

We saw also many other interesting things such as tanks, gasometers, etc., busy in the purification and storing of the gas, but for the most part we had to be content with observing their external beauties. The various processes seemed very complicated and we wondered what Murdock, the pioneer of gas lighting, would have thought about it all, had he been able to accompany us!

I am afraid we must have removed a great deal of the company's property in the form of soot deposited on our faces, in our eyes and on our clothes, but no charge was made for this!

J. A. CHISHOLM (Douglas, I.O.M.)

The Ross Sea Whaling Fleet

Probably there are many readers of the *"M.M."* who have never heard of the Norwegian whaling fleet that sails every summer from Stewart Island, New Zealand, to that region of ice and snow known as the Ross Sea. The fleet consists of several small "scouts," whose duty it is to catch whales and bring them to the two factory ships, the *"C. A. Larson"* and *"Sir James Clark Ross."* The former is 17,000 tons and the latter 12,000. The men on the small vessels suffer great hardship, as the decks are low and even in a slight swell seas break over them. The crews of the two factory ships, of course, have a more comfortable time. These large ships are hives of industry. They are anchored among the ice floes and they render down the captured whales and store the oil in barrels. Approximately between 600 and 700 whales are caught each season.

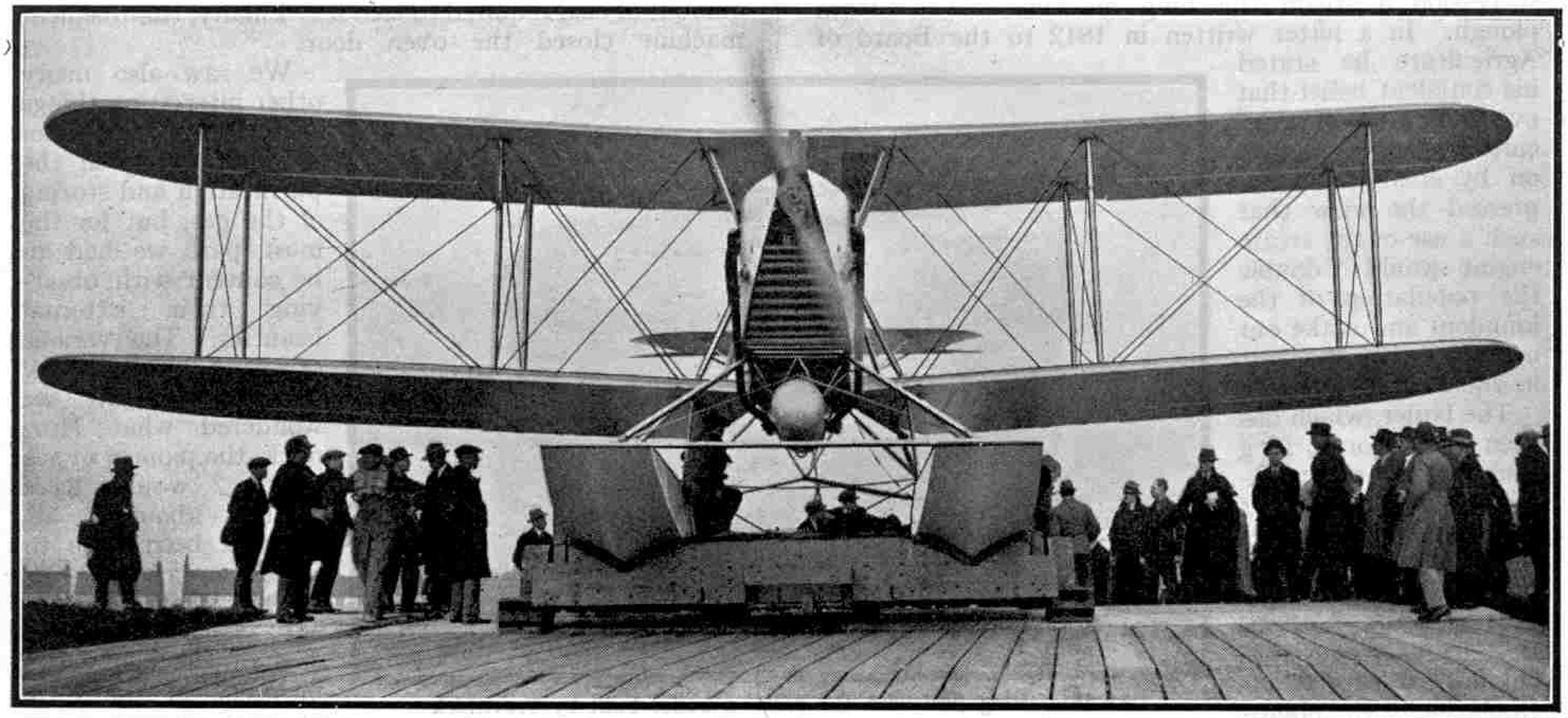
An interesting fact is that, on account of the proximity of the magnetic pole, the ordinary compass is almost useless and therefore all the small ships are equipped with Marconi direction finders.

The Ross Sea was discovered by Sir James Clark Ross in 1841, during his four-year Antarctic exploration cruise. On the east the sea is flanked by South Victoria Land, on the west by King Edward VII. land, while the southern boundary is formed by the Ross Barrier—a gigantic ice wall, with cliffs towering 200 ft. to 300 ft. in height. The barrier extends for hundreds of miles.

G. MACKAY (Invercargill, N.Z.)

The Conquest of the Air

XXV. The Blackburn "*Velos*" Torpedo-Plane



THE story of torpedo-carrying aeroplanes and seaplanes is still more or less in its early chapters.

The first experiments in releasing torpedoes from aeroplanes were conducted by Lieut. (now General) Guidoni in Italy, some years before the Great War, but it was not until the early part of 1914 that tests were made in England, at the Royal Naval Air Service Depôt, Calshot. The machine used for those experiments was a "Borel" mounted on floats, but little or no success was attained as the machine was too small for the purpose.

With the outbreak of war progress became more rapid, and the first work of importance was carried out by a British officer, Flight-Commdr. Edmonds, at Gallipoli. Carrying a standard service torpedo—slung between the floats of one of the early "Short" seaplanes, equipped with a Sunbeam engine—he climbed over the Gallipoli Peninsula to the Sea of Marmora. There, just outside Maidos, he discovered a Turkish troopship at anchor, and while taxi-ing along the surface of the water he managed to release the torpedo successfully. The aim was perfect and the torpedo got home. It is true that the troopship only sank on to a bed of mud 3 ft. below her keel, but great possibilities were revealed.

The Germans carried out a few moderately successful raids, sinking one or two ships while at anchor in the Downs, and on another occasion launched a torpedo into the harbour of a town on the S.E. coast. Fortunately the torpedo did not hit anything but piled itself up on the beach without causing any damage.

The Blackburn "*Velos*" is one of the most interesting of the modern types of torpedo-carrying machines and is designed to operate either as a seaplane, with floats, or as a deck-landing machine using an ordinary land chassis which, of course, also renders the machine suitable for land work. The "*Velos*" is a development of two earlier torpedo-carrying machines constructed by the Blackburn Company—the "*Swift*" and the "*Dart*," the latter being the standard torpedoplane now employed by the Royal Air Force. The "*Dart*" is a slightly modified form of the "*Swift*," both machines being single-seaters, designed as deck-landing machines with land chassis.

The "*Velos*" is an improvement upon the earlier

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2.	Beardmore "Wee Bee I."	Apl.	,,
3.	Super-Seaplanes for U.S. Navy	May	,,
4.	Airman's Attempt to Circle the Earth ...	June	,,
5.	Parnall "Pixie III."	July	,,
6.	De Havilland "Moth"	Aug.	,,
7.	Beardmore-Rohrbach Flying Boat ...	Oct.	,,
8.	Fokker C.V. Scout	Nov.	,,
9.	Vickers "Vimy" Ambulance	Dec.	,,
10.	The Cierva Auto-Giro Flying Machine ...	Jan.	1926
11.	Boulton "Bugle"	Feb.	,,
12.	The Flight from London to the Cape ...	Mar.	1926
13.	Light Aeroplane Clubs	Apl.	,,
14.	D.H. 54 (de Havilland) "Highclere" ...	May	,,
15.	Vickers (Rolls-Royce) "Vanguard" ...	June	,,
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19.	The Parnall "Plover"	Nov.	,,
20.	Sir Alan Cobham's Flight to Australia	Dec.	,,
21.	"Southampton" Supermarine Flying Boat	Jan.	1927
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24.	A Tail-less Monoplane	Apl.	,,

types and, while it is the first seaplane to be produced for torpedo and bombing work, it retains a speedy adaptability to deck and land work. The provision of a gunner's cockpit with a Lewis machine-gun behind the pilot's cockpit renders the machine capable of defending itself, thus dispensing with the necessity for aerial escort, a point that tends to add to the machine's mobility in actual warfare.

The material, workmanship and equipment put into the "*Velos*" are all of the highest order and, as our illustrations show, her lines are remarkably clean, while at the same time embodying the great strength necessary to enable a machine of this type successfully to accomplish its mission.

The equipment of the "*Velos*" includes a wireless installation capable of transmission and reception over a range of 200 miles; an electric telephone, entirely independent of the wireless set, for use between the pilot and the gunner; and a complete lighting plant for night flying. Flotation air bags are provided inside the fuselage in case of a forced descent into the sea, and the slinging gear provided makes rapid hauling of the machine aboard ship a matter of ease.

The method of carrying the torpedo, between the floats and immediately under the fuselage, is shown in the illustration on the previous page. When it is desired to release the torpedo, the machine dives quickly with the engine cut off. At the right moment the release is raised and the torpedo discharged, the machine meanwhile climbing skyward again.

Dropping the Torpedo

The engine is the famous Napier "Lion," rated at 450 h.p. This has twelve cylinders, arranged on the broad arrow design in three rows of four, the weight of the engine per horse power developed being slightly less than 2.1 lb.

The total weight of the machine when fully loaded is 3,351 lb., of which the torpedo accounts for 1,500 lb. When carrying this weight the maximum speed of the machine at sea level is 95 knots when fitted with land chassis, and 86 knots when fitted with floats, these speeds being equivalent to approximately 110 m.p.h. and 100 m.p.h. Fitted with a land chassis, the machine can climb at the rate of 650 ft. per minute to a maximum height of 15,000 ft., the equivalent figures with floats being 585 ft. per minute and 13,000 ft.

The machine is equipped to carry a cargo of bombs as an alternative to the torpedo if required, and in such cases the total weight carried would be the same as that with a torpedo, the number of bombs varying according to their individual weights.

The "*Velos*" is one of the machines now being constructed at the Greek Government Aircraft Factory at Old Phalerum, near Athens, which has been organised and staffed by employees of the Blackburn Company.

Since the development of the "*Velos*" the Blackburn Company have introduced the "*Cubaroo,*" a colossal type of torpedoplane for long-distance coastal defence work. This machine is driven by a 1,000 h.p. Napier "Cub" engine and carries a 21 in. torpedo weighing 1½ tons. Other still more advanced machines are being developed —some actually are in existence and others are in the design stage—but particulars cannot be disclosed at present.

Buying Heavy Engineering Plant—

(*Continued from page* 445)

feet to get the necessary head for the pump to work against, the same effect is obtained by partially closing the throttle valve in the discharge pipe until the pressure-gauge reads the required head. In order that the customer may see that the pump is delivering the quantity of water required, a venturi-meter, which is an instrument which shows the rate at which water is flowing through it, is placed in the discharge pipe.

After the pump has passed its tests it is partly taken down, the bearings are examined, and it is given a good clean, after which it goes to the paint shop, where it is painted and has all its bright parts well greased to prevent corrosion.

The packing department receives it next and prepares it for the journey to its destination, packing also all spare parts, tools and other gear that belong to it. When it is all ready, the despatch department send it off and advise the customer that it is on the way.

On the arrival of the pump at the mine, some of the outside erecting staff of the works will take it in hand, installing it on its foundations, coupling it to its driving source and probably installing any necessary pipework, and finally testing it to see that everything is all right. If this is the case, it is officially handed over to the customer, and after he has checked over the specification to see that it is correct, the contract is discharged.

It will be seen, therefore, that buying heavy machinery is not quite as simple as buying a model engine, and that, except in rare cases, it is not possible to buy engineering plant "over the counter!"

Over 200 Miles an Hour—

(*Continued from page* 393)

The tyres, it may be noted, are special plain Dunlops. They were tested prior to leaving the works by rotating them at a speed of 190 miles an hour with the actual load that they were designed to carry. The same test applied to an older type of racing tyre resulted in the tread being ripped off with a noise like an explosion and hurled through the door of the test hut!

Each power unit has its own independent radiator mounted directly in front of it. The forward one obtains its cooling draught from a large rectangular hole cut in the nose of the car, while two scoops feed the rear one. The wheel base is 11 ft. 9 in., track 5 ft. 2 in., but by careful design the height has been reduced to under 4 ft. When seated in the car the driver is actually nearer the ground than he would be in an ordinary household chair. In the tail there is mounted a 28-gallon petrol tank which, however, does not hold enough to drive the car for more than 63 miles.

New Zealand (1927) Model-Building Competition

We again take the opportunity to draw the attention of all readers who reside in New Zealand to the splendid new competition that has been organised by our agents for that country, Browning, Ifwersen Ltd. Entries in the competition will be divided into several sections according to the ages of the competitors. Many handsome prizes, consisting of Meccano or Hornby Train goods to be chosen by the winners, are offered for entries showing particular merit. The contest is limited to New Zealand Meccano boys, and all entries must be received not later than 4.30 p.m., June 30th next. Would-be competitors may obtain their entry forms and all necessary particulars from their Meccano dealers or direct from Browning, Ifwersen Ltd., P.O. Box 129, Auckland, N.Z.

Model Railway Time-Table Working

Getting More Fun Out of Your Train Set

By R. Lucas

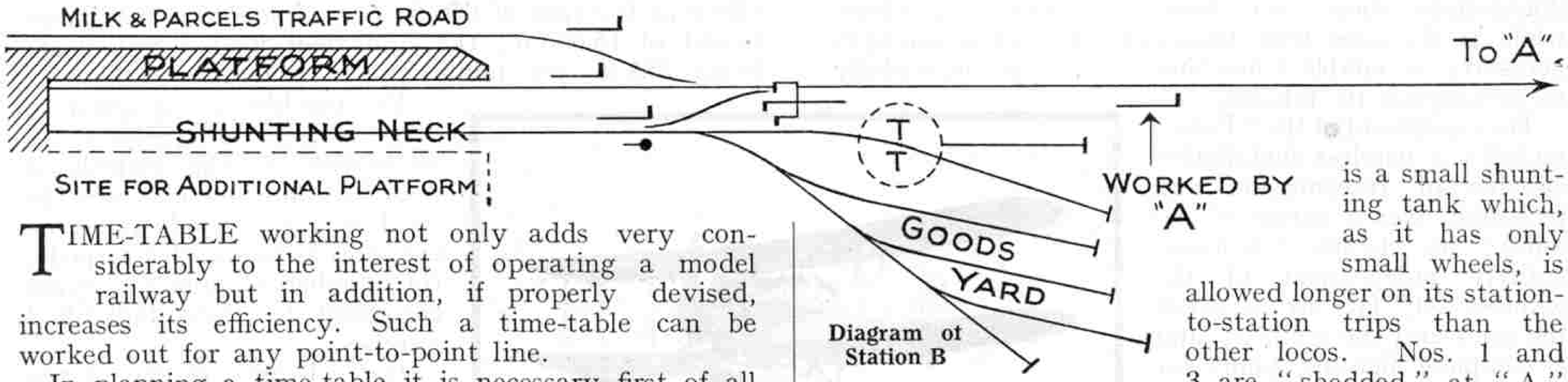


Diagram of Station B

TIME-TABLE working not only adds very considerably to the interest of operating a model railway but in addition, if properly devised, increases its efficiency. Such a time-table can be worked out for any point-to-point line.

In planning a time-table it is necessary first of all to ascertain the time taken by the various locos to haul their respective trains from one station to the other. The following notes are based on the working of a branch (single line) on the writer's own railway. The time allowed for passenger trains is 30 seconds, although the actual time taken by a fast train is usually only 20 seconds. Thus a train may be as much as 10 seconds late without seriously affecting the other trains.

As will be seen from the accompanying plans, each station is provided with a passenger platform, goods yard and loco sidings, while station "A" has also a separate platform to deal with parcels and milk traffic, this being the exchange point for the main line (not shown). All locos and trains are confined to the branch, so that it is entirely separate from the rest of the railway and is complete in itself.

Signalling at both stations is complete. A feature of interest is that in each case the advance starting signals are worked by the signalman at the next station, so that a train may not leave one station until it is definitely signalled by the other. This arrangement prevents any misunderstanding after the block bell signals have been exchanged, because when the signalman at "B" is able to take a train offered by "A," he lowers "A's" advance starting signal, thus indicating a clear line at least as far as "B's" platform "home" signals.

Traffic is operated by three locos, two of which, Nos. 1 and 2, are passenger tender locos, while No. 3 is a small shunting tank which, as it has only small wheels, is allowed longer on its station-to-station trips than the other locos. Nos. 1 and 3 are "shedded" at "A" together with the passenger train, while No. 2 is kept at station "B."

As a rule the locos are changed at "B," the same loco taking out incoming trains at "A," and as each class of traffic is dealt with on a separate line no confusion need arise concerning the line to be used for any particular train movement. Information of this kind is given in the movement list for the station concerned.

The "Train Movement Sheet" should give details of all trains arriving and departing, all loco movements and all regular shunting movements, together with other information regarding train working. The lists are in force as long as the time-table proper, and special lists may be drawn up to show the working of special trains, etc., not shown in the permanent list.

"Extra Vehicles" include milk and parcel vans, and on arrival at "A" they are shunted by the train back into the carriage dock to be unloaded at the special platform. At station "B" these vans are taken off the arriving train by the loco that is to take the train out, and shunted into platform 2, the loco then backing on to the train again.

A rule is in force at "B" providing that goods trains about to leave must be drawn out of the yard on to the shunting neck by the loco waiting in the engine siding, the train loco backing on afterwards.

All extra vehicles on passenger trains must be placed at the rear of the train. Only express goods wagons

Working Instruction for Station "A"

0½	Signal Dn. Pass.	(1)
1	Dep. Dn. Pass. Loco 1	(1)
2½	Signal Up Pass.	(2)
3	Arr. Up Pass. Loco 2 Reverse Loco	(2)
4½	Signal Dn. Pass	(3)
5	Dep. Dn. Pass.	(3)
6½	Signal Up Pass.	(4)
7	Arr. Up Pass. Loco to TT and GY Goods Train (5) to GL by Loco 1 Attach Loco 3 to train 5 Signal Dn. Goods	(4) (5)
8	Dep. Dn. Goods Loco 1 GL–TT and Reverse	(5)
8½	Signal Dn. Pass.	(6)
9	Dep. Dn. Pass.	(6)
10½	Signal Up Pass.	(7)
11	Arr. Up Pass. Reverse Loco	(7)
12	Signal Up Goods	(8)
12¾	Arr. Up Goods Loco 3	(8)
	Signal Dn. Pass.	(9)
13½	Dep. Dn. Pass. Shunt Loco 3 and Up Gds. (8) to GY	(9)
14½	Signal Up Pass.	(10)
15	Arr. Up Pass. Reverse loco (without winding) but shunt to crossover only Shunt Xp. Goods (11) GY–GL Loco 3 Signal Dn. Xp. Goods Attach Loco 1 and wind	(10)
17½	Dep. Xp. Goods Shunt Loco 3 to Pass. Coaches (12) Signal Dn EC	(11)
18¼	Dep. Dn. EC	(12)
20	Signal Up Pass.	(13)
20½	Arr. Up Pass. Loco to TT only	(13)
21	Signal Up Goods	(14)
21½	Arr. Up Goods Loco 3 Shunt to yard Loco 2 on TT and Reverse Signal Dn. Pass.	(14) (14) (15)
22½	Dep. Dn. Pass.	(15)
23½	Signal Up Pass.	(16)
24	Arr. Up Pass. Reverse Loco	(16)
25½	Signal Dn. Pass.	(17)
26	Dep. Dn. Pass.	(17)
27½	Signal Up Pass.	(18)
28	Arr. Up Pass. Reverse Loco	(18)

(Figures in brackets indicate train numbers as per time-table).

Abbreviations

Dn. Pass.	– Down Passenger Train	GL.	– Goods Loop
Up Pass.	– Up " "	GY.	– Goods Yard
Gds. and Xp.	Goods and Express	Dn. EC.	– Down Empty Coaches
Gds.	– Goods	"Reverse Loco"	Run engine to TT, turn, and run via goods loop on to other end of train.
Dep.	– Departure		
Arr.	– Arrival		
TT.	– Turntable		

and vans may be taken by such trains and then only by those specially marked.

The foregoing instructions are similar to those shown in actual railway working books, and it is only by abiding by them that the trains may be safely and punctually run.

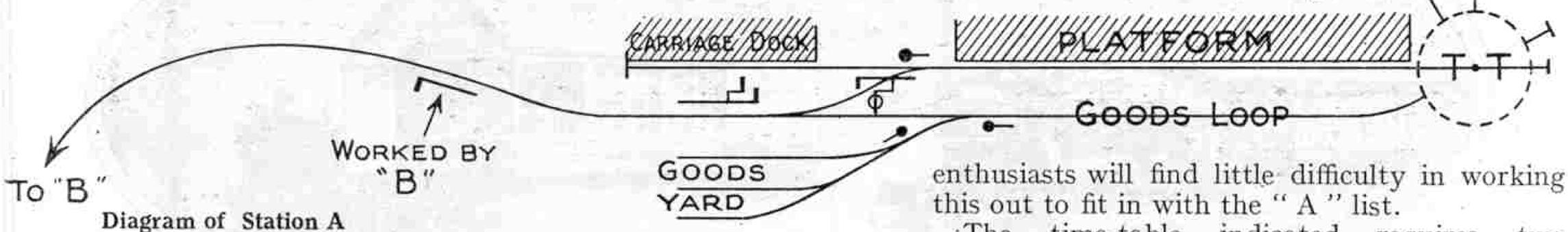


Diagram of Station A

It may be mentioned that the times shown in the time-table are minutes and fractions of a minute, but if preferred seconds may be used instead of fractions. Thus "$1\frac{1}{2}$" might be written "1.30;" "$2\frac{1}{4}$" might be "2.15," etc.

The accompanying working instructions are for station "A." Of course a similar list must be drawn up for station "B," and model railway enthusiasts will find little difficulty in working this out to fit in with the "A" list.

The time-table indicated requires two operators and it will be found that smart work is necessary at times if everything is to be carried out smoothly and without mishap.

From Cowboy to College Student—

(*Continued from page* 423)

doubt, if I hadn't felt a little urge for some excitement one morning three years later, and placed a fake bomb in the city hall. The joke was more successful than I had anticipated. One of the city commissioners jumped through two panes of window glass and landed in the snow a storey below with a few cuts and bruises. It was a foolish joke—I came to realize afterwards—and I got what I deserved—dismissal from the "*Herald.*"

I still had my athletics to fall back upon; so I decided again to go to Los Angeles and turn pro. I was more confident now than ever, for I had boxed with Dempsey in Calgary two months before, and he had said to me: "If I had you three months, Chief, I could make a champion of you." So, to Dempsey, at Los Angeles I would go. But again, it was not to be. I missed the weekly boat from Vancouver to Los Angeles, and had neither enough money left to go by train or remain in Vancouver a week for another boat.

Again fate had decreed that brawn should give way to brain. With many regrets that I had overslept that morning, I went over to the Vancouver "*Sun*" and got a job there. For six months I travelled through British Columbia and parts of Alaska, visiting all of the Indian tribes and writing their story for the Sunday feature section of the "*Sun.*" That province completed, I decided to do this in every province in the West; so I went to Regina and wrote the history of the Indian tribes of Saskatchewan for the Regina "*Leader.*" Later, I signed with the Winnipeg "*Tribune*" to cover the Indians of Manitoba for their feature section.

"I'm Proud to be Like a White Man"

It was about this time that I was successful in selling a series of articles to "*MacLean's Magazine,*" and I might count my comparative success as a free lance from that date. I wrote for "*MacLean's*" and the Toronto "*Star Weekly*" for almost a year. Then I was taken on the staff of Press Department of the Canadian Pacific Railway, from which I have not yet been fired. I spend my summers at Banff, and through the personal contacts which the Canadian Pacific has enabled me to make with the editing and publishing world I am now having some success as a magazine and newspaper contributor.

As a result I am pretty much of a free man. I travel about a bit, lecture a bit, write a bit—and when summer comes I'm up in the Rockies. My play-work at Banff is better than being all the prize-fight champions in the world.

Two or three times a year I go back to my Indian reservation, where I spent my boyhood and where my people still live. I was proud when they elected me a Chief. I had won my spurs fighting side by side with the white men—and my tribe had recognized this.

I'm proud to be as much like a white man as I am—but I'm proud, too, of every drop of Indian blood that runs through my veins. I'm proud of my Indian heritage—and I'm proud too, of the land and people of my adoption.

I have reached no dizzy heights of material success, but I have succeeded in pulling myself up by my bootstraps from a primitive and backward life into this great new world of white civilization.

Anyone with determination and will can do as much, and more, in his own sphere.

Famous Trains—(*continued from page* 433)

level, and it is along here that our engine and her crew will show their progress. Mile after mile will be ticked off at an even speed of 68 to 72 miles an hour, and an average of round about 70—really marvellous work with such a load as 525 tons behind the tender. The speed will be slightly interrupted by a slowing to about 50 an hour through Abbeville, 75 miles from the start, but after that we shall go on unchecked until we are nearing Amiens. The station here is so sharply curved that a reduction to 15 miles an hour is imperative, and we shall find it rigidly observed. We have now covered 103 miles of our journey.

At Amiens the direct line to the East of France and Switzerland, via Laon, leaves us on the left, and three miles later, at Longueau, we are joined on the left by the main line from Lille and Arras. Here we shall notice the extensive reconstruction works which have been carried out since the war, as this stretch of line represents the limit of the great German advance in 1918. After Longueau the engine is faced with a long climb, of all but 25 miles, up to Gannes. It is not steep; for most of the distance it is at 1 in 333, or almost exactly the same as the climbs on the North Western main line up to Tring, from both directions. In the last three miles, however, the climb steepens to 1 in 250. We shall forge steadily up to Gannes at a speed but little short of 60 m.p.h., and then down the corresponding descent to Creil speed will once again rule well up in the "seventies," till we thread that station at a reduced speed of about 50 an hour.

We have now $31\frac{1}{4}$ miles left of our journey, and a little over half-an-hour in which to cover them. From just beyond Creil, where we are joined on the left by the main line from Brussels and Berlin to Paris, our driver is faced with a 12-mile ascent at 1 in 200—exactly the same inclination as the rise from Wood Green to Potter's Bar, on the L.N.E.R. main line, but half as long again. Even up this bank we shall travel, probably, at a round 55 miles an hour, and then a swift final dash down a bank of precisely the same length and steepness will bring us from Survilliers Summit down to St. Denis—a very important railway centre, well inside the Paris suburbs. Five minutes later we are drawing up in the Gare du Nord.

The only task now remaining is to muster up our best French, and go and congratulate the driver and fireman. To have worked a load some six times the weight of the engine over the grades that we have just recounted, with foreign coal, at an average speed of 58 miles an hour throughout, with due observance of the various slacks and no higher maximum speed than 75 miles an hour, is a feat indeed. And yet it is being done every day by the "*Golden Arrow.*"

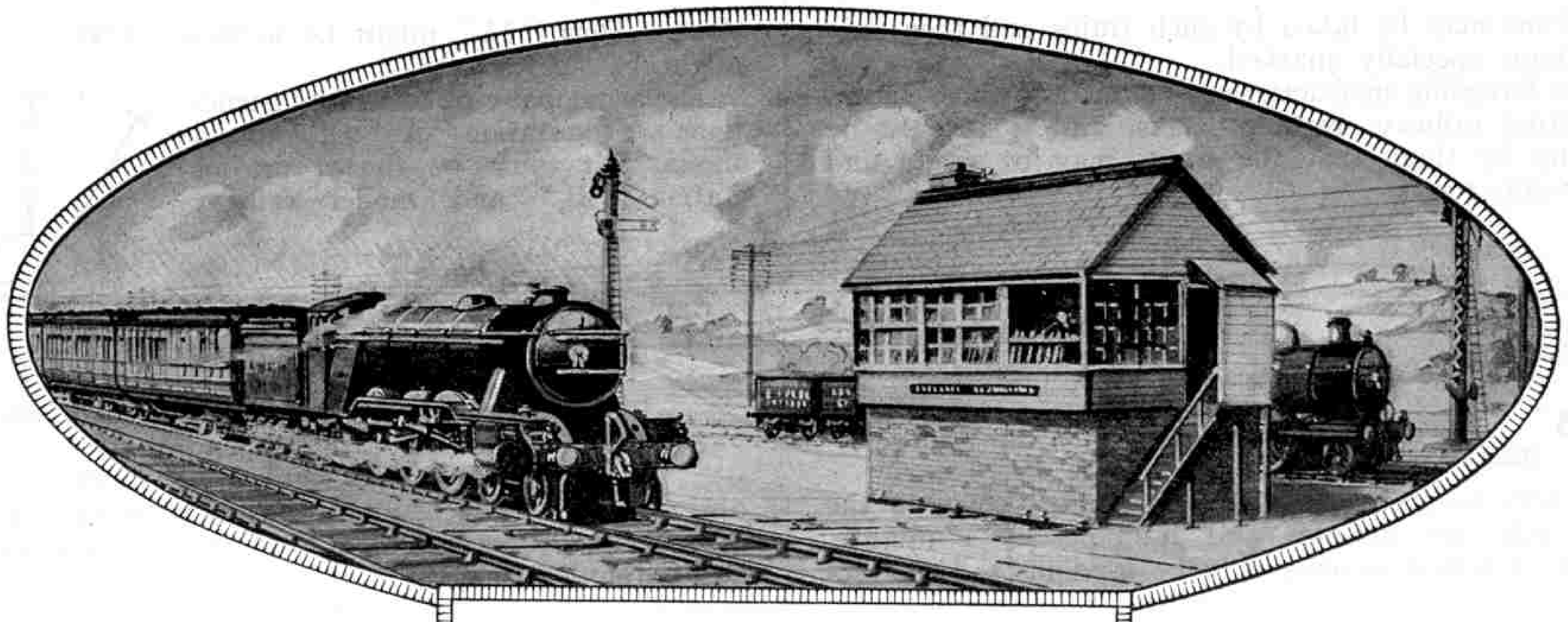
Southern Railway's New Posters

British railway posters are acknowledged to be the finest in the world and this reputation is worthily upheld by the Southern Railway's latest productions.

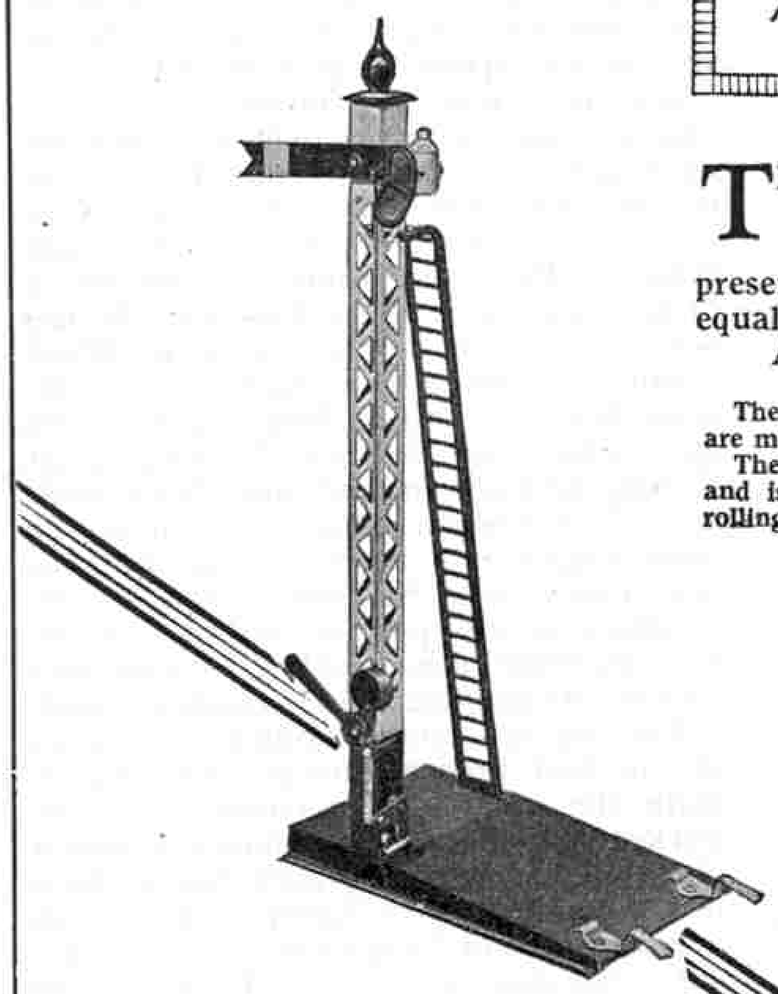
The new series consists of four posters which are the work of Mr. Donald Maxwell, the well-known artist and author. The subjects are respectively:—"Devil's Chimney" (Sussex); "The Enchanted Forest" (Hampshire); "The Magic Castle" (Corfe, Dorset); and "The Magician's Cave" (Tintagel, North Cornwall).

The four posters are treated in a highly imaginative style and Mr. Maxwell is to be congratulated on his success in producing the correct atmosphere for the legend "Once upon a Time," which forms the keynote of the series. Wonderful things happen to the man with "a green charm"—which charm is cunningly reproduced and is seen to be—a railway ticket!

Copies of these posters (price 2/6) may be obtained from the Advertising Department, Southern Railway, Waterloo, London, S.E. 1.



SIGNALS AND POINTS CONTROLLED, AND TRAINS STARTED, STOPPED AND REVERSED FROM THE SIGNAL CABIN



THE Hornby Control System enables you to manipulate the Signals and Points in conjunction with the running of your trains, entirely by the operation of levers in your Signal Cabin. The installation of the system is quite a simple matter, no phase of it presenting any difficulty whatever. Large or small railway layouts may be operated with equal simplicity.

Ask your dealer for a Hornby Control System folder which fully describes the system.

The component parts in the Hornby Control System are made up in two different Outfits.

The No. 1 Outfit is for use with rails of 1 ft. radius and is intended for operation with No. 1 locos and rolling stock.

The No. 2 Control Outfit is designed for rails of 2 ft. radius and is intended for use with the new type of No. 2, Metropolitan clockwork and "Blue" Train clockwork locos.

PRICE LIST

HORNBY CONTROL OUTFITS

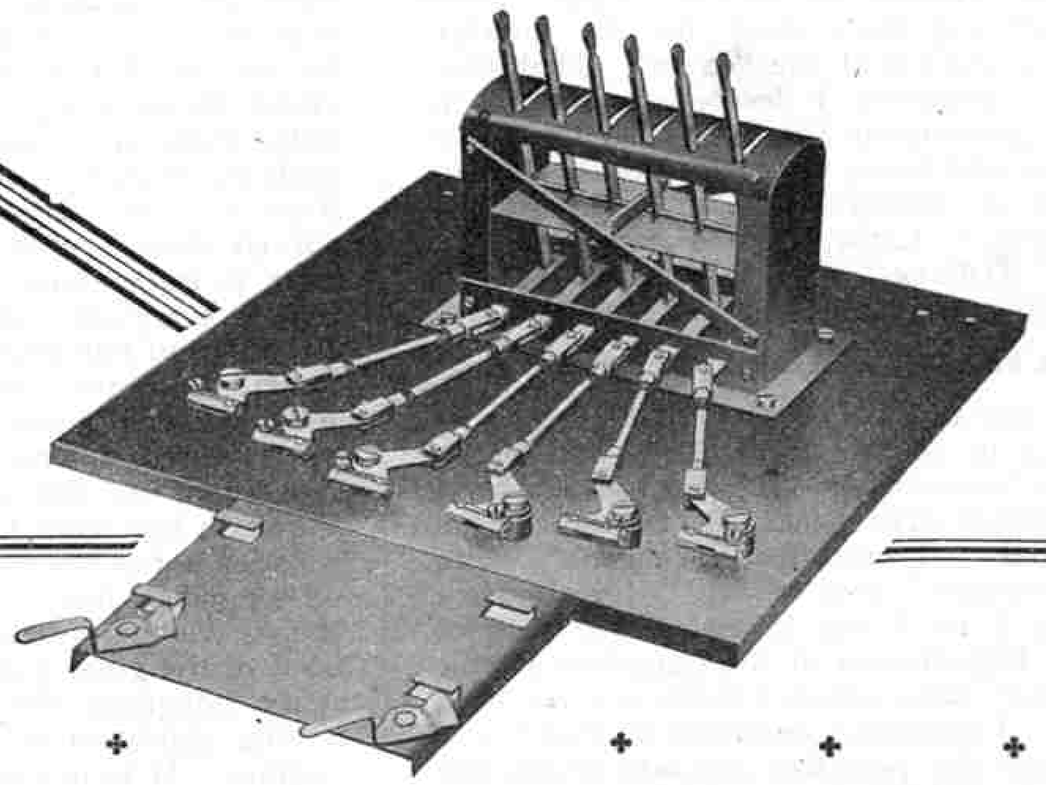
No. 1 Outfit Complete (for use with No. 1 locos)	35/–
No. 2 Outfit Complete (for use with new type No. 2, Metropolitan No. 3 and "Blue" Train No. 2 locos	35/–

* HORNBY TRAIN SETS AND LOCOS FITTED FOR HORNBY CONTROL

No. 2 Pullman Set	65/–	No. 1 Tank Goods Set	28/6
No. 2 Riviera "Blue" Train Set	70/–	No. 2 Goods Set...	40/–
No. 2 Tank Passenger Set ...	50/–	No. 2 Tank Goods Set	50/–
No. 3 Metropolitan Train Set ...	55/–	No. 1 Tank Loco	15/–
No. 1 Goods Set...	24/6	No. 1 Loco	16/–

* The loco in each case is fitted with a special cam which is operated by a Hornby Control Rail. This rail is included in all these train sets and locos.

The Hornby Control System



Control *Your* Trains from Your Signal Cabin + + + + + +

MECCANO LTD. BINNS ROAD LIVERPOOL

Keeping Up to Date

Some Hints for Hornby Railway Owners

By Charles Garner

A GREAT deal of the wonderful success of the Hornby Train System has been due to a consistent policy of progress and development. New and improved engines have been produced, points and crossings of new types have been added and accessories of all kinds have followed one another in quick succession. The latest introduction is one of the most striking in the whole history of Hornby Trains—namely, the Hornby Control System.

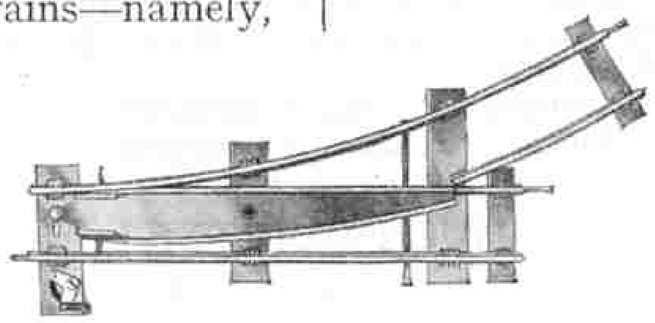
A signal box is a welcome addition and one that vastly improves the appearance of any miniature railway, but a signal box without levers is not by any means all that could be desired. The youthful railway proprietor is apt to feel that in some manner he is being "cheated," and that this accessory should be useful in addition to being merely ornamental. It is not a case of "much would have more," but simply resentment that the signal box, so far from being what it purports to represent, is merely a dummy.

This is exactly where the Hornby Control System steps in. By a simple arrangement of guides that are attached to the sleepers of the permanent way, the various points and signals can be connected up to the signal box. This means the elimination of numerous scattered points and the consequent rush to reach them in time to avert an accident, since by this method the control is operated entirely from one central position.

It is certain that there must be large numbers of Hornby Railway owners who would like to introduce the Control System in their layouts, but who find themselves unable to purchase the new-style points that are required. These enthusiasts probably will be interested to know that it is not necessary to purchase entirely new points, for the old ones may be adapted with little trouble or expense.

The first thing to do is to write to Meccano Limited stating the number of points to be converted and giving particulars as to whether the pull is right-hand or left-hand. The firm will then supply new sleepers for control points, price eightpence each, fitted with bell crank and coupling. Thus equipped, even those who have not the slightest pretension to mechanical ability can transform the old method of working the points individually by hand into the present up-to-date method of operating them from the signalbox.

The appliances needed are a small blow lamp such as can be obtained anywhere for 1/6; a small quantity of methylated spirits; a tin of liquid solder costing about 1/3; a hammer and a punch. The mention of solder may excite alarm but there is no need for this. The skill of a plumber is not required and in fact it is not necessary to have any knowledge of soldering at all.



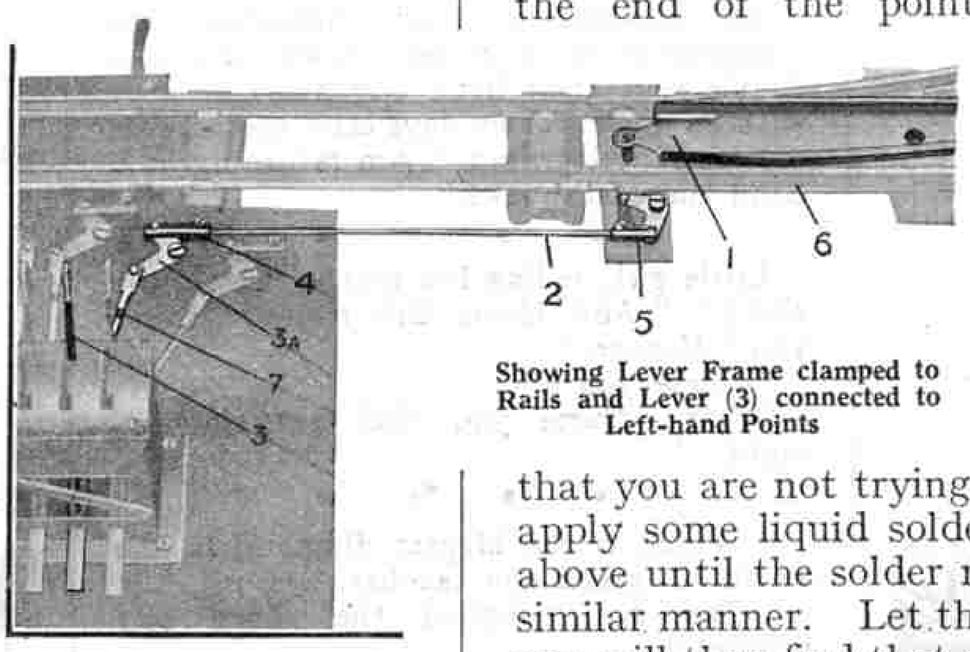
Control Points, L.H., 1 ft. or 2 ft.

Having filled the lamp and lighted it, take one of the points and heat the end of the sleeper where it has been soldered. When the solder is in a state of flux, force down the bottom part of the box of which the sleeper is formed, by means of an old penknife blade. Then heat the other end of the sleeper and pull the bottom completely off. The next step is to move the rod from the centre of the points. This is clipped by a piece of metal midway between the lever and the centre. Bend down the clip from the top and the deed is done.

Now heat the rails where they are fastened to the top of the sleeper and in a minute or so the solder will become fluid. Then prise up the lugs from the flange of the sleeper. A broken blade of a penknife is most suitable for this purpose, but it is not necessary to worry if you do not possess a broken blade in your knife. Use an unbroken blade for the first lug and you will have a broken blade ready to prise up the next one!

This concludes the destructive part of the work!

Take the new sleeper and slip the rail through beneath the lugs, and push the pin into place in the centre of the end of the points. Place the bottom of the pin upon some flat piece of metal and by means of hammer and punch flatten over the head so that it is riveted.

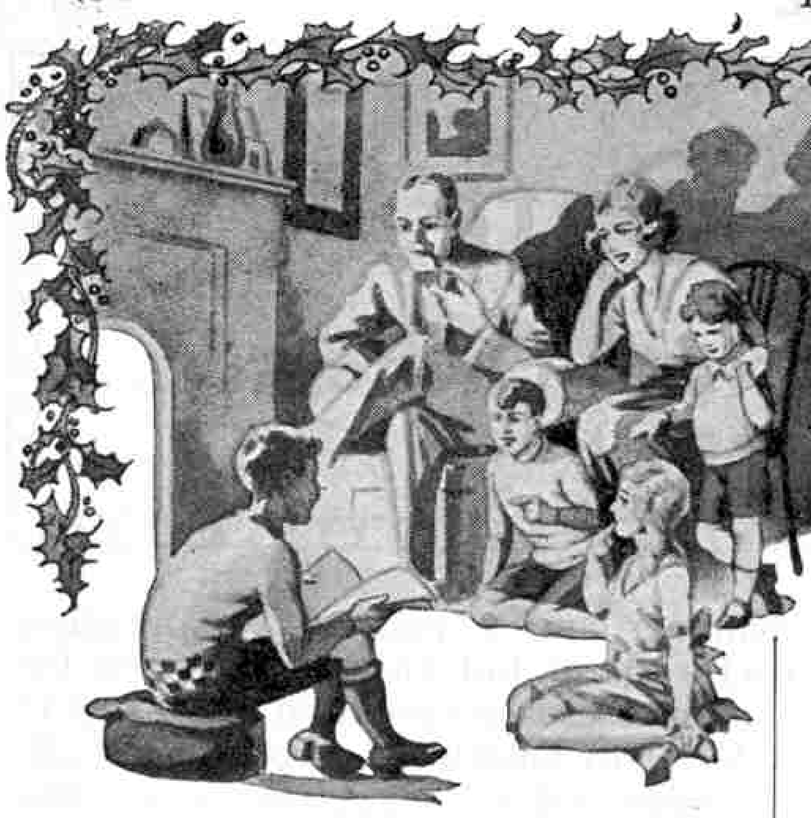


Showing Lever Frame clamped to Rails and Lever (3) connected to Left-hand Points

Bring the lugs into the position occupied by the old ones on the flanges of the rails and press them down tightly. This also may be done by hammer and punch, so long as you realise that you are not trying to beat out a horse shoe! Now apply some liquid solder to the lugs and heat the rail above until the solder melts; solder the other rail in a similar manner. Let the points stand for a moment and you will then find that you have turned out a good solid job. If by any chance the rail is not firmly fixed to the sleeper put on some more solder and heat again.

The whole process is exceedingly simple. There is just one thing to remember, namely, that it is advisable to make sure that the metal is free from dirt, otherwise the solder may not adhere properly.

The other points are treated in the same manner, after which all that is necessary is to fix the wire rodding connecting the points to the signal lever frame and the permanent way is then up to date.



Fireside Fun

SUSPICIOUS!

A man was charged with shooting a number of pigeons, the property of a farmer. The solicitor for the defence tried to frighten the farmer.

"Now," he remarked, "are you prepared to swear that this man shot your pigeons?"

"I didn't say he did shoot 'em," was the reply. "I said I suspected him of doing it."

"Ah! Now we're coming to it. What made you suspect that man?"

"Well, firstly, I caught him on my land with a gun. Secondly, I heard a gun go off and saw some pigeons fall. Thirdly, I found four of my pigeons in his pocket—and I don't believe them birds flew there and committed suicide!"

* * * *

Clerk: "Sir, the superintendent of police wants to see you."

Merchant: "Wha- What?"

Clerk: "He wants to buy something, sir."

Merchant: "Why did you not tell me that beforehand, you idiot! You nearly scared me tc death!"

* * * *

OH, ARCHIBALD!

It was quite the first time Archibald had ever seen a coal mine and he was eager to gain information.

"Can you—aw—tell me," he said to a collier, "how you—aw—get those johnnies out of that beastly hole, fellar?"

"Yus," replied the collier, who was not taking any chaff, "we—aw—pulls 'em hup—aw, doncherknow, by the 'air of their 'ead!"

"How jolly interesting! But I say, I'm a whale for information. How do you manage the bald-headed johnnies?"

FROM THE LIMERICKS COMPETITION

A girl who weighs many an oz,
Used language I will not pronoz.
Her brother one day,
Pulled her chair right away;
He wanted to see if she'd boz.

* * * *

Wife: "This pudding is a sample of the new cook's work. What do you think of it?"

Husband: "I call it mediocre."

Wife: "No, dear, it's tapioca."

* * * *

MUCH QUIETER!

An earthquake had frightened the inhabitants of a certain town and one couple sent their little boy away to stay with an uncle. Two days later the parents received a telegram: "Am returning boy. Send the earthquake."

* * * *

Little girl, telling her mother about the party: "And Uncle Bill recited 'Curse you,' Mother."

"Curse you?"

"Yes! Curse you shall not ring to-night!"

* * * *

"Which is the biggest diamond in the world?" asked the teacher.

"The ace," replied the sharp boy promptly.

* * * *

A SPORTING CHANCE!

A. "Do you have to rush to catch your morning train?"

B. "Oh! it's about an even chance. Sometimes I am standing at the station when the train comes puffing in, and other times the train is standing at the station when I come puffing in."

* * * *

Q. What is the centre of gravity?

A. The letter V.

THE EXPERT!

A man was being questioned by an employer on his suitability for a fairly important job as a mechanic.

"But," said the employer, "are you an all-round man—a thoroughly trained mechanic?"

"Oh, yes," the man assured him, "for six years I had experience at the Ford Works."

"And what did you do there all that time?"

"Well," said the man, "I screwed on nut 467."

* * * *

Mr. Newlywed: "What's that you're putting on the bacon, dear?"

Mrs. Newlywed: "Some 'Lux.'"

Mr. Newlywed: "Good heavens! What for?"

Mrs. Newlywed: "Well, it says on this packet, 'Lux prevents shrinking.'"

* * * *

Old Gentleman (seeing waits about to strike up beneath his window): "How much will you take to go away?"

Leader: "Two bob."

Old Gentleman: "It isn't worth it."

Leader: "Wait till you 'ear us sing."

* * * *

Indignant lady, telephoning: "Why hasn't your man come to fix our door bell?"

"He was there twice to-day, madam," replied a voice at the other end, "and he rang and rang and no one came to the door!"

* * * *

Tramp: "Could yer help a pore chap guv'nor? I hav'nt had a bite for 24 hours."

Angler: "Ah! You must have been using the wrong bait, like myself."

* * * *

ANOTHER VIEWPOINT!

Patient (who has met with an accident): "Is it serious, doctor?"

Doctor (rubbing his hands in satisfaction): "Splendid, my dear chap, splendid! Your leg has been broken in four places!"

A SUCCESSFUL RUSE!

The young man had no experience in collecting debts, but he was desperately in need of a job, and was quite willing to tackle almost anything.

The merchant to whom he had applied for a job hadn't much faith in his ability, and more to get rid of him than anything, gave him an old account against a man who had the reputation of owing everybody and paying nothing until he had to.

"If you collect this money," he said to the young man, "I will give you a regular job."

To the merchant's astonishment, the young man returned in half-an-hour with the money.

"H-h-how did you do it?" he gasped.

"I told him," said the young man, "that if he didn't pay me, I would tell all his other creditors that he had done so."

* * *

A man spending the day at Blackpool amused himself in the afternoon by trying all the penny-in-the-slot machines on the piers. In due course, he came to one that didn't respond to his bronze.

"Look here," he said to an attendant, "that machine is to try your weight, the next to it your height, that one your strength, the other your sight, the one over there your lungs, and—and now I've put a penny in this darned thing, but I don't see what it's for!"

"That, guv'nor?" answered the pierman. "Oh, that one's to try your temper!"

* * *

A woman was once brought before a judge, who asked her name.

"Angel," replied the woman.

"Where did you come from?"

"Heaven."

"Well, how did you get here?"

"Slid down a rainbow."

"Take 14 days for skylarking!"

* * *

CALM AND COLLECTED!

During an examination a scholar was asked to write a short story introducing the words "Calm and collected!" This is what the schoolmaster read.

"One day an absent-minded professor was crossing a busy street when, to his consternation, he discovered traffic bearing down upon him from two directions. With great presence of mind he stood quite calm. The traffic passed——and he was collected."

NOT TO BE CAUGHT!

The bright lad had been given a start in the timber yard, and was putting in his first day in the order office.

In due course there entered to him one of the old hands, bent on pulling the youngster's leg.

"Hey! sonny," he said, "a customer wants fifty feet of knotty wood without knots."

The boy thought for a moment, and then replied: "Tell him we have just sent the last we had round to the brewery to make bung-holes for barrels."

Courtesy [*Sentinel Wagon Works Ltd.*

Making Tracks: Bunkum's Publicity Lion

Bore: "How long have I been talking? My watch has stopped."

Audience in chorus: "There's a calendar in the hall!"

* * * *

A DEAL IN FUTURES!

Insurance Salesman (over the 'phone): "Is that Mr. Jones? How would you like your wife and child to receive ten pounds a week after your death? Now our ——."

Jones: "Very much indeed, thank you! I wish 'em luck. By the way do you supply the wife and child?"

NOT THE VICAR'S!

In a remote Cheshire village, the G.P.O. officials had erected a new pillar-box, painted bright red. The village children gathered round in consternation and at once proceeded to discuss its ownership. One said it belonged to the squire, another said it belonged to the doctor, while a third assigned it to the vicar. On hearing the latter suggestion a bright little fellow at the back remarked—"How can it belong to the vicar when it says: 'No collection on Sundays?'"

* * *

"So you've been fighting again!" said teacher. "Haven't you been taught that when you're struck on one cheek you should turn the other?"

"Yes," said the little boy. "But he hit me on the nose, and I've only got one!"

* * *

A suburban minister, during his discourse one Sunday morning, said: "In each blade of grass there is a sermon."

A day or two after, one of his flock discovered the good man pushing a lawn mower about, and paused to say: "Well, parson, I'm glad to see you engaged in cutting your sermons short."

* * *

Joe: "I say, Jim, what does 'p.m.' mean on that railway bill?"

Jim: "Oh! that means—that—that means 'a penny a mile!'"

"But what does 'a.m.' mean?"

"Oh! that, er—an 'apenny a mile."

* * *

Furious Passenger (as train is moving off) "Why didn't you put my luggage in as I told you?"

Porter: "Eh, mon; yer luggage is no sich a fule as yersel'. Ye're in the wrong train."

* * *

"How are you getting along at home since your wife is away?" "Fine, I've reached the highest point of efficiency. I can put on my socks from either end."

* * * *

A HORSE MARINE!

First soldier: "Once about ten of the enemy attacked me, and I killed the lot of them, and escaped."

Second soldier: "That's nothing. I had my hoss shot from underneath me in the battle of Jutland."

* * * *

Teacher: "So we have a White Sea, a Red Sea, a Black Sea and a Yellow Sea. Murphy, show them on the map."

Murphy: "I can't, sir, I'm colour blind!"

HE'S been batting for an hour. He has staying power. You, too, would like to do big things. You, too, must have a reserve of strength to draw upon.

Eat " FORCE " because it is nature's greatest strength giver—whole-wheat.

Eat " FORCE " because its crisp toasted flakes are the very finest food you ever tasted. Eat " FORCE " daily with milk or with fruit, and get the benefit of its extra nourishment.

FORCE

WHOLE WHEAT FLAKES

MALTED AND TOASTED

The Energy Generator

SIGN THIS TO BRING YOU A FREE SAMPLE OF "FORCE"

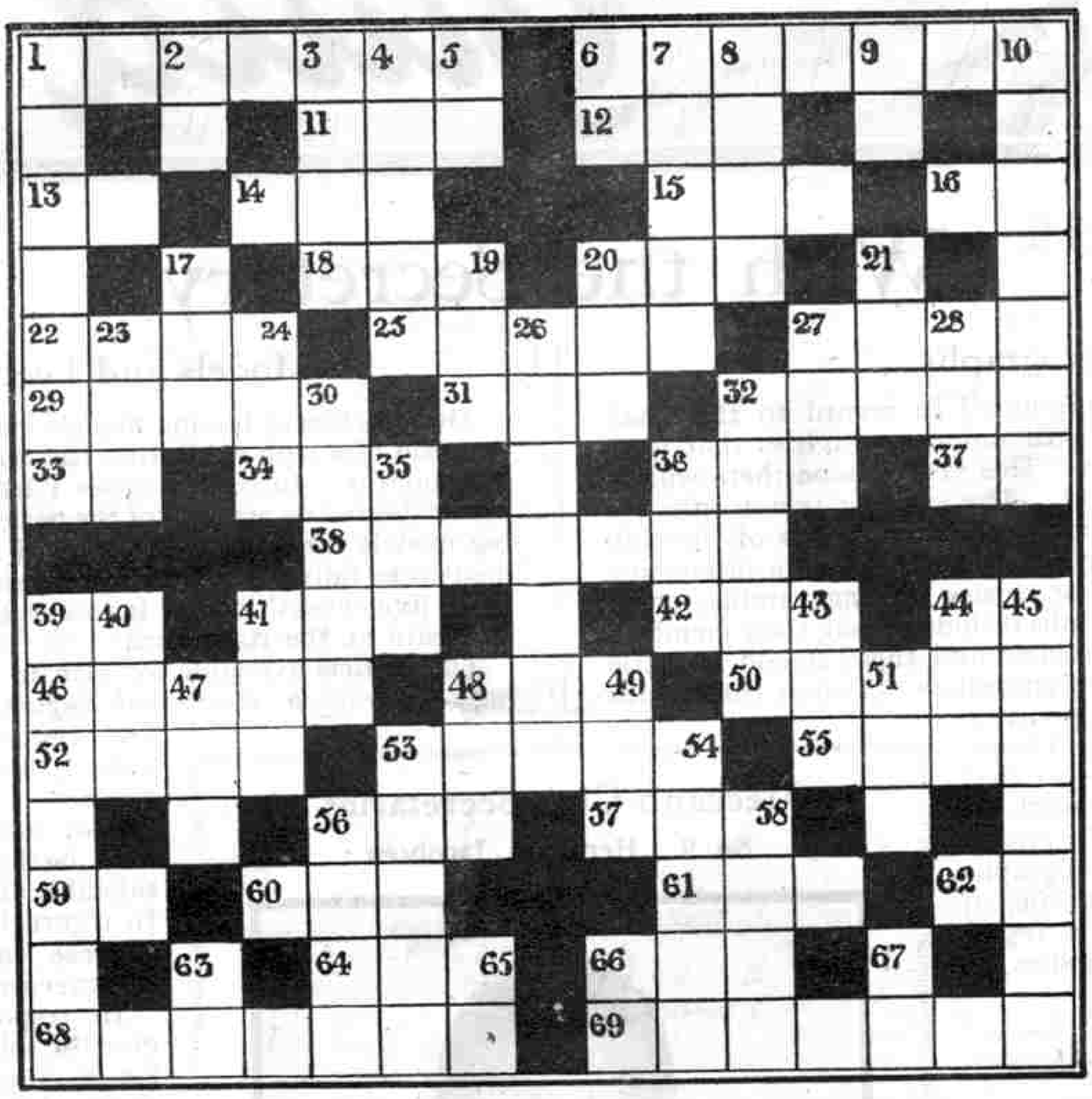
YOUR NAME.....

YOUR ADDRESS.....

FILL IN AND POST TO:- "SUNNY JIM," 197, GT. PORTLAND STREET, LONDON, W.1

Competition Page

A NEW CROSSWORD PUZZLE



CLUES ACROSS

1. A garment of the Elizabethan era.
6. A tutor.
11. Signifies addition.
12. Impure metal.
13. As has been stated.
14. A lucky chance.
15. Pouch.
16. Mixed mass of type.
18. Free from moisture.
20. In trouble.
22. Eagle.
25. One of a collection of hymns and prayers.
27. Repose.
29. Well known.
31. Member of Pharmaceutical Society (abbrev.)
32. A coniferous tree.
33. A note in the tonic sol-fa scale.
34. Sluggish.
36. Knack.
37. From the sign (It. abbrev.)
38. Remains.
39. Always.
41. In good condition.
42. Order of St. Francis (abbrev.)
44. Objective of we.
46. Hoarded.
48. Port of London Authority (abbrev.)
50. Fan palms.
52. The inside covering of a ship's ribs.
53. The lachrymal secretion.
55. An unidentified weed.
56. A floor covering.
57. The singular of those.
59. 1st person singular of verb to be.
60. A human organ.
61. A weapon.
62. An interjection.
64. By way of.
66. Eggs.
68. Conspicuous.
69. Help.

CLUES DOWN

1. A minority protest.
2. An interjection.
3. Prostrate.
4. Your submission to this contest.
5. Territorial Decoration (abbrev.)
6. Perform.
7. A planet's path.
8. Powdered grain.
9. Negative.
10. Concealed meanings.
17. An insect.
19. A potato-like root.
20. In the year of human salvation (Lat. abbrev.)
21. A resin used in dyeing.
23. A female hart.
24. A slimy fish.
26. A small spade.
27. An expression of contempt.
28. Pasturage.
30. A man's name.
32. To Squeeze.
35. Seize.
36. Gone.
39. Allay.
40. The Tibetan ox.
41. Low marshy land.
43. Gross.
44. An armed contest.
45. Exhilarate.
47. Force.
48. A wooden pin.
49. Practical skill.
51. Prohibition.
53. An Italian city.
54. A thin cut.
56. To converse irrationally.
58. By word of mouth.
63. An unfortunate Chinese astronomer.
65. Near.
66. Conjunction.
67. A male person.

Many of our readers have written from time to time asking that crossword puzzles be introduced on the Competition Page again. Unfortunately, it has not been found possible to comply with this request until this month, but we hope to insert these entertaining puzzles at intervals in the future. Crossword puzzles need no explanation, but on one point we are happy to be able to make ourselves clear. It has been our endeavour as far as possible to avoid the use of words that have bothering alternatives and, therefore, the puzzle set here will be found to be quite straightforward. Every word used will be found in Chambers' 20th Century Dictionary.

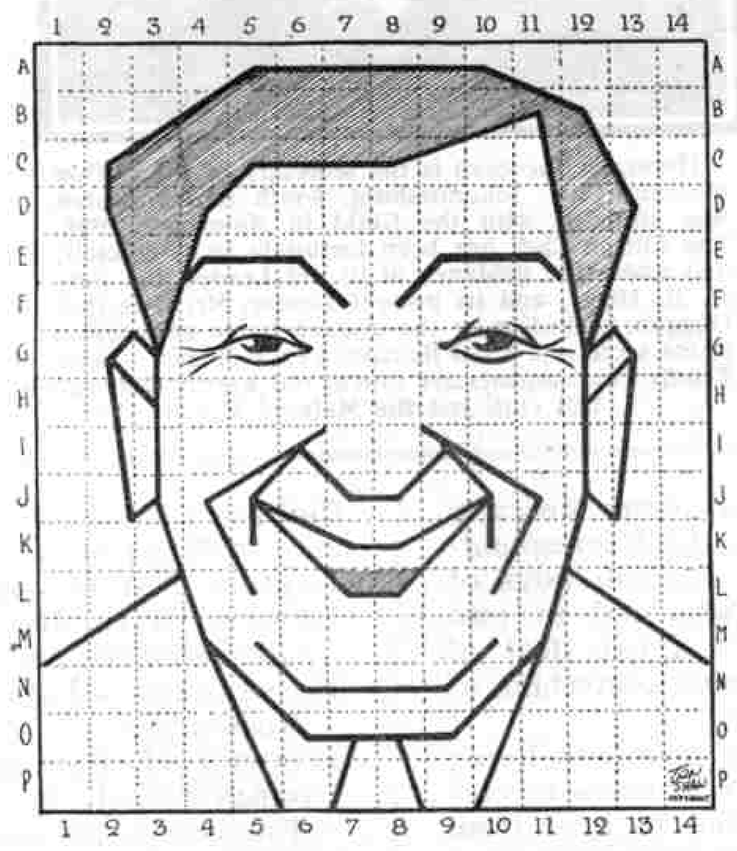
Prizes of Meccano products to the value of £1-1s.-0d., 15/- and 10/6 respectively will be awarded to the competitors who submit the three most successful entries, and in addition there will be a number of consolation prizes. Entries must be addressed to "Crossword Puzzles, Meccano Magazine, Binns Road, Liverpool," and must be sent to reach this office not later than 31st May. Overseas closing date, 31st August.

May Essay

At this time of the year, we are all looking forward to the delights of long days in the open, whether they are spent in the saddle, wielding a cricket bat or tennis racket or simply tramping over fields and country by-paths. Could any month be more suitable to tell us of your outdoor plans for 1927? Readers generally will welcome an opportunity of explaining in essay form their reasons for preferring one summer pastime to another.

Essays must be entitled "My Favourite Summer Pastime" and must not exceed 500 words in length. Only the entrant's name, address, and age are to appear on the back of each sheet used.

There will be two sections, A for those 16 and over, B for those under 16. Cash prizes value 15/- and 7/6 respectively will be awarded to the two best entries in each section and in addition there will be a number of consolation prizes. Closing date 31st May; Overseas, 31st August.



The Meccano Boy's Dad

Home Result

Meccano Boy's Dad Cartoon

The Magazine department of Meccanoland has been even more cheerful than usual during the past few weeks. The reason? Simply the infectious smile that beamed from the top of stack after stack of entries to the Meccano "Dad" cartoon competition. Who could resist it? Even the postman smiled when he saw a completed drawing and he really has had to put in some hard work, for every mail brought shoals of entries.

The standard of the entries was very high but detailed comment is unnecessary as the completed cartoon is shown in the preceding column.

After careful consideration "Uncle Ern" and the Editor made the awards detailed below.

1. G. Pepper (Dublin); 2. J. W. Rose (Aberdeen); 3. G. E. Williams (St. Helens); 4. T. Barlow (Epping).

Consolation Prizes: G. Allen (Sheffield); L. C. C. Bryant (Bristol); W. Foster (Widnes); C. Harman (Lympne, Kent); J. Harrison (Camden Town, N.W.1); G. O. Harne (Muswell Hill, N.10); M. Easton (West Hallam); E. Mitchell (Chester).

Very highly commended: R. Adams (Deal); S. Axtell (W. Byfleet); P. Bainbridge (Hull); P. Barrie (Golders Green); J. C. Bulleyment (Hull); E. C. Burrage (Stroud Green); H. B. Fisher (Stow-on-the-Wold); H. L. Hodges (Sittingbourne); E. V. Hutt (Dulwich); B. Phelp (Hale End); N. Rowntree (Tottenham); H. Saunders (Hounslow).

OBJECTS of the GUILD

To make every boy's life brighter and happier.

To foster clean-mindedness, truthfulness, ambition and initiative in boys.

To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

The Meccano Guild

With the Secretary

Club Photographs

Last year I was a little disappointed in regard to the small number of photographs dealing with summer activities that were sent in to me by club secretaries. This year I hope there will be a big improvement in this respect. The summer is not only the best time of the year for obtaining good photographs of the club as a whole, but also it provides endless opportunities for interesting snapshots of episodes in camp or during a long ramble, or of cricket and other games. Most clubs include among their members two or three photographic enthusiasts and there should be little difficulty in securing the necessary snapshots. Two or three clubs have adopted the scheme of appointing one of their members "Official Photographer," and arranging matters so that he is not out of pocket on any work he does for the club. This is done by charging a small price for copies of photographs and there is no difficulty in disposing of these, for every member who is represented in a group naturally wishes to have one.

Inter-Club Cricket Matches

The unequal distribution of Meccano clubs throughout the country makes it practically impossible to adopt the suggestion of a Meccano League that is so frequently made. A great deal more might be done, however, by clubs themselves in arranging cricket matches with other clubs in their neighbourhood. There is nothing more enjoyable than a friendly match of this nature especially if, as is often possible, it is followed by tea and a joint meeting to exchange views on the many matters of mutual interest. I shall be glad to give any assistance I can in furthering meetings of this kind, but of course, the local arrangements must be made by the clubs concerned.

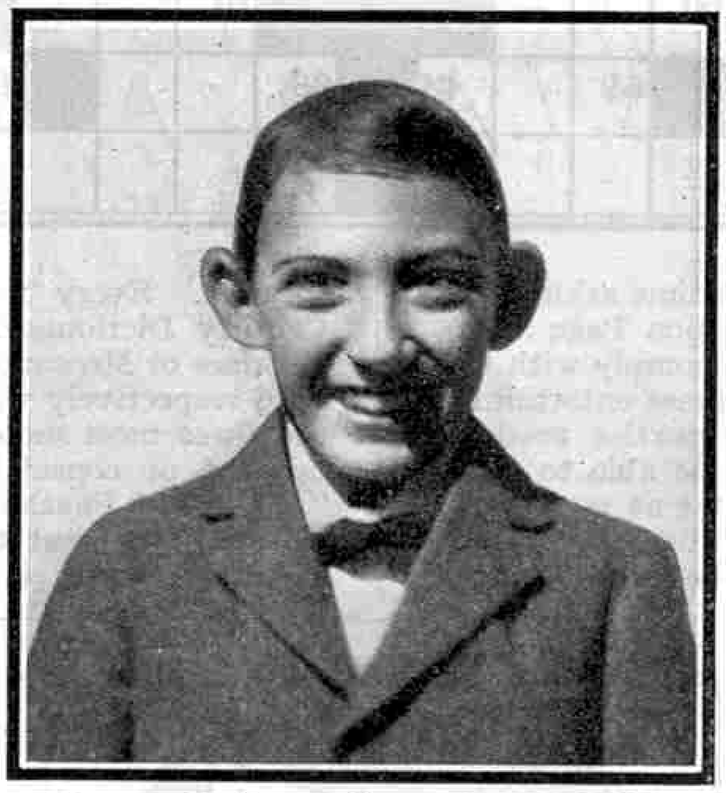
Correspondents Wanted

Among the more recently enrolled members of the Correspondence Club are large numbers of English boys who wish to be put into communication with correspondents in the United States, Canada and Australia. I should like many more Meccano boys living in these parts of the world to join the Correspondence Club and enter into correspondence with English boys of their own age and interests. Meccano boys who fail to join the Correspondence Club undoubtedly miss a great deal of fun and lose an excellent opportunity of learning something of the interesting lives of boys in other countries.

I have also on my lists several enthusiastic members living in Malta and in the Straits Settlements who are anxious to correspond with English boys. I shall be very glad to hear from any member who would care to be placed in communication with one of these boys.

Meccano Club Secretaries

No. 9. Hermann Jacobsen



Hermann Jacobsen is the secretary of the Clifton Meccano Club, Johannesburg, South Africa, which was affiliated with the Guild in November 1926. The Clifton Club has been fortunate in its officials, and under the guidance of its old Leader, the Rev. H. R. Higgs, and its present Leader, Mr. Beresford Duggan, backed up by the unquenchable enthusiasm of the secretary, it has flourished exceedingly. Table Tennis Tournaments are fought out keenly between this club and the Malvern M.C.

Models and Lectures for Loan

The practice of having models loaned from Headquarters on the occasion of a club exhibition has increased rapidly during the past few months. In certain cases I have been unable to provide the model desired on account of the notice given being too short. These big models are specially built, and as the Meccano Model Department is so fully occupied in other ways it is necessary that I should have five weeks' notice in order to ensure that the model will be ready at the right time.

The models available for loan to affiliated clubs are the following:—*Workshop, Horizontal Engine, Derricking Crane, Big Wheel and Aeroscope, each fitted with a* 220-*volt motor; Motor Chassis fitted with a* 4-*volt motor; Meccanograph.* Occasionally special models not included in this list may be loaned, but in such cases considerably longer notice must be given. In regard to the loan of models the only expense incurred by the club is the return carriage on the model.

In response to numerous requests I give the following list of lectures available for loaning to affiliated clubs:—"*The Story of the Motor Car*"; "*Some of the World's Famous Bridges*"; "*The Story of Our Ships*"; "*The Men Who Gave Us Radio*"; "*The Story of Spinning and Weaving*"; "*Lives of Inventors*"; "*Lives of Famous Engineers.*" It is hoped to add several new lectures to this list for the coming winter session.

A Reminder

Once more I wish to draw the attention of club Leaders to the fact that two Special Merit Medallions are awarded to each affiliated club for each of the summer sessions, as well as for the winter sessions. These Medallions may be awarded for any kind of good work for the club. During the summer months there are wide opportunities for enthusiastic members in connection with games, rambles, camps, etc., and I hope Leaders will not omit to send in their two recommendations each session.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested should communicate with the promoters whose names and addresses are given:—

LONDON, S.W.11.—A. Towe, 4, Dorothy Road, Battersea, S.W.11.

LONDON, W.1.—Ronald H. Pike, 11, George Yard, Duke Street, Grosvenor Square, W.1.

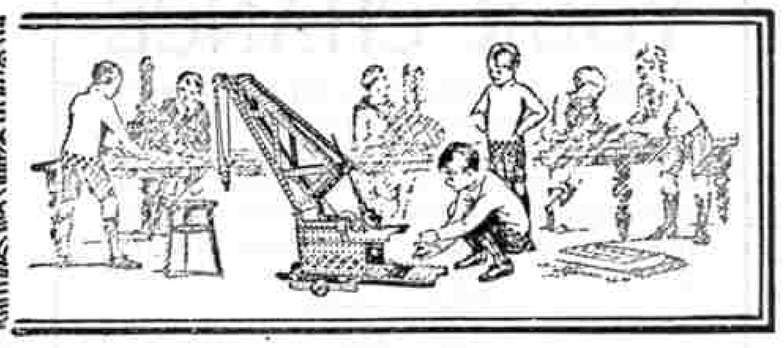
ROSSENDALE.—John Rudge, 11, Laund Street, Rawtenstall, Rossendale.

DARWEN—J. Eatough, 16, Bridge Street, Darwen.

EDGBASTON—J. R. D. Hill, Lindenhurst, Richmond Hill Road, Edgbaston, Birmingham.

ASHTON-UNDER-LYNE—Lawrence Bell, 7, Cobden, Ashton-under-Lyne.

CLUB NOTES



Pinxton M.C.—Is making excellent progress with the aid of Mr. T. Litchfield, an old Scoutmaster, and Mr. T. Cope, Assistant Scoutmaster. Signalling, Tracking, First Aid, and Cycling are popular features, and it is hoped to form a Cricket Team. Each section is to have an outing during the summer and one section is living in hopes of visiting Guild Headquarters. Club roll: 59. *Secretary*: Master H. Elliot, "Ivanhoe Villa," The Green, Pinxton, Nottingham.

Holy Trinity (Blackburn) M.C.—A recent Exhibition proved highly successful and the sum of £7-5s.-0d. was handed over to the Sale of Work fund. Two representatives of the Haslingden M.C. were present and stayed to tea. A Hornby Layout was on view and attracted much attention, and many of the boys exhibited drawings done by themselves. New officers have been elected and they are to meet once a month to decide on the programme for the following month. Activities include Mock Trials, Games Nights and Library Night and an attempt is being made to start a Club Magazine. Club roll: 30. *Secretary*: Tom Donald, 6, Camden Street, Blackburn.

Brighton (Dublin) M.C.—Several outings have taken place and a Draughts Tournament proved very successful. A Crossword Puzzle Competition was keenly contested. Games Evenings and Model-building are popular features of the syllabus. An Exhibition is under consideration. The Club is being well advertised in the district and new members will be made very welcome. Club roll: 12. *Secretary*: W. Malone, 3, Pretoria Terrace, Harolds Cross Road, Dublin.

Beccles Excelsior M.C.—An Exhibition of Meccano Models was incorporated in the local Exhibition of Flowering Bulbs. The Meccano Stall attracted much attention and the boys were highly praised for their work. A Horizontal Engine was loaned from Headquarters, and visitors at the Exhibition seemed surprised that such models could be made from Meccano. The model is to be retained for one club meeting as the boys were too busy at the time to see it properly for themselves. The proceeds from the Meccano stall were presented to the Exhibition Fund as a token of appreciation for the use of the club-room. Club roll: 24. *Secretary*: B. J. Andrews, 30, Station Road, Beccles.

Hessle M.C.—Satisfactory progress is reported but the attendance has been low owing to the 'flu' epidemic. The club has been divided into two sections, namely, "The Engineers" and "The Railway." During the summer indoor meetings will not be held regularly as more outdoor work is to be done. Occasionally people from the village visit the club and show a keen interest in the work. Club roll: 21. *Secretary*: T. A. Fillingham, Red Lea, Marlbro Avenue, Hessle.

West Leeds High School M.C.—Lectures are popular, and the "Story of Our Ships" was loaned from Headquarters and read at a recent meeting. An interesting lecture by A. Hudson on "Trinidad" was greatly enjoyed by all. An Inventor's Night brought forth many interesting models. Club roll: 49. *Secretary*: B. Mather, "Lynridge," Ridge Road, Armley, Leeds.

Withington M.C.—Model-building Evenings are held frequently and Stamp Evenings are very popular, members bringing their albums and exchanging stamps with one another. A Motor Chassis Model was loaned from Headquarters and this was studied by the members. Arrangements for the future include Model-building, Lectures, First Aid and a "Do-as-you-like" Evening. Members hope to pay a visit to Liverpool shortly. Club roll: 11. *Secretary*: K. Cradduck, 36, Mauldeth Road West, Withington, Manchester.

St. Peter Mancroft (Norwich) M.C.—Model-building is a prominent feature of the syllabus. A Social recently organised was a success, about 100 people being present. There were Games and Competitions, and refreshments were served during the evening. Mr. Eagle, the Sub-Leader, has been elected Chairman and a Committee of six members has been formed. Club roll: 40. *Secretary*: Lionel H. Oates, 18, Civic Gardens, Mile Cross, Norwich.

Central Hackney M.C.—Meetings are held every Saturday at Eleanor Road L.C.C. School at 6.30 and new members will be welcome. Model-building is a popular feature and an Exhibition has been organised. Several enjoyable visits have been paid to the Museum. Five-minute Speeches by members are quite popular, and Model Railway Evenings are held at frequent intervals. Club Roll: 60. *Secretary*: Harold Michel, 49, Middleton Road, Dalston, E.8.

Rotherham M.C.—Model-building Contests are held monthly and the models entered show great talent. The Contest for March was quite a novel one, entrants being required to build "anything that runs in the street." Railway, Dockside, Motor Bridge, Crane and Machine Tool Contests also are to be organised. Club roll: 27. *Secretary*: A. E. Wood, 26, Norfolk Street, Rotherham.

Cranham M.C.—Model-building is popular and the boys bring their outfits to meetings. Mat-making is also a prominent feature of the syllabus. It is hoped to take up the study of animal life during the summer. *Secretary:* John G. Cheshire, Post Office, Cranham.

Wiseman's Meccano Club. N.Z.

Our photograph shows some of the members of Wiseman's M.C., Auckland, New Zealand, which has the distinction of being the largest Meccano Club in the world. It was founded in 1924 by Mr. Frank Wiseman, whose interest in it has never waned and who is now its President. The unique success of the club is very largely due to the splendid work of Mr. W. Shearer in the joint position of Leader and Secretary

Great Baddow M.C.—A Visitor's Evening held recently was a huge success and the club-room was well filled. Many interesting models were exhibited, among the most prominent being an Eiffel Tower, a Motor Plough, a Motor Train and a Windmill. Prizes and Medals were awarded for the best work and these were presented by Mrs. Stanley Beale. The Misses G. and D. Pitts very kindly gave piano solos and songs. Mr. and Mrs. Stanley Beale have very kindly invited the club to spend an afternoon at their grounds in the Summer and stay to supper. Miss D. K. French has kindly undertaken the duty of secretary. Club roll: 23. *Secretary*: Miss D. K. French, High Street, Gt. Baddow.

Annan M.C.—Lessons in Miniature Rifle Shooting have been given by Mr. Gibbons, the leader, and have proved remarkably popular. An Exhibition has been organized and the proceeds are to be handed over to the local Y.M.C.A. The club now possesses a No. 5 Meccano Outfit in addition to several smaller Outfits. An Electric Motor is to be purchased for club use. Club roll: 15. *Secretary*: Oswald Gibbs, 6, Addison Place, Annan.

Clubs not yet Affiliated

South Liverpool M.C.—A Leader has not yet been secured and the secretary finds it difficult to carry on. Anyone in the district who is interested and willing to help should communicate with Arthur Hague, 16, Rutherford Road, Mossley Hill, Liverpool.

Central (Hastings) M.C.—A Leader and a club-room have been secured and several successful meetings have been held. This club is open to all Guild members over twelve years of age living in Hastings and district, and the secretary will be very pleased to hear from any boy who is interested. Several adults in the district are willing to give all the help possible in making the club a success. *Secretary*: William V. Veness, 9, Earl Street, Hastings.

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(*Stamp Advertisements continued on page* 476)

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60	,, ...	1/6	6	Contract ...	4d.
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Stamp Collecting

FORTY YEARS RULER OF ROUMANIA

IT is doubtful whether any country in Europe has experienced a more turbulent struggle for existence during the last two centuries than has fallen to the lot of Roumania, an independent kingdom located in South East Europe, bounded on its north and west sides by the Carpathian Mountains, on its southern side by the river Danube and on the east by the river Dniester.

The real development of Roumania begins with the reign of Alexander. Ascending the throne in 1859, he immediately commenced the introduction of a number of reforms, many of which were of great value to the country. Unfortunately, however, his reforms connected with the ownership of land were unwise and resulted in his becoming more and more unpopular. Finally the people became so exasperated that on the 23rd February 1866, they revolted, burst into the palace and forced Alexander to sign a decree of abdication.

The leaders of the people set up a provisional Government pending the selection of another ruler and ultimately the choice fell upon Prince Charles of Hohenzollern. Charles travelled in disguise across Austria and arrived at Turna Severin on 8th May 1866. Two days later, amid scenes of great enthusiasm, he took the oath before the Roumanian Government at Bucharest as Carol, Hereditary Prince of Roumania.

The scene at the taking of the oath is depicted on the 1b. stamp of the Roumanian stamp issue of 1906, the issue taking the form of a special set to commemorate the completion of 40 years' rulership by Carol. The complete set is illustrated on this and the succeeding page and it should be noted that the centre of each stamp is in black, the perforation being 12.

Roumania was formed by the union of the two Danubian provinces Walachia and Moldavia, and at this period was still to a considerable extent under Turkish domination. Prince Carol immediately set himself the two-fold task of throwing off definitely and finally the yoke of Turkey and of establishing a constitutional Government. The first three years after his accession were comparatively tranquil, and in 1869 he married Elizabeth, daughter of the Princess of Weid. This Princess Elizabeth later became famous as the authoress "*Carmen Sylva.*"

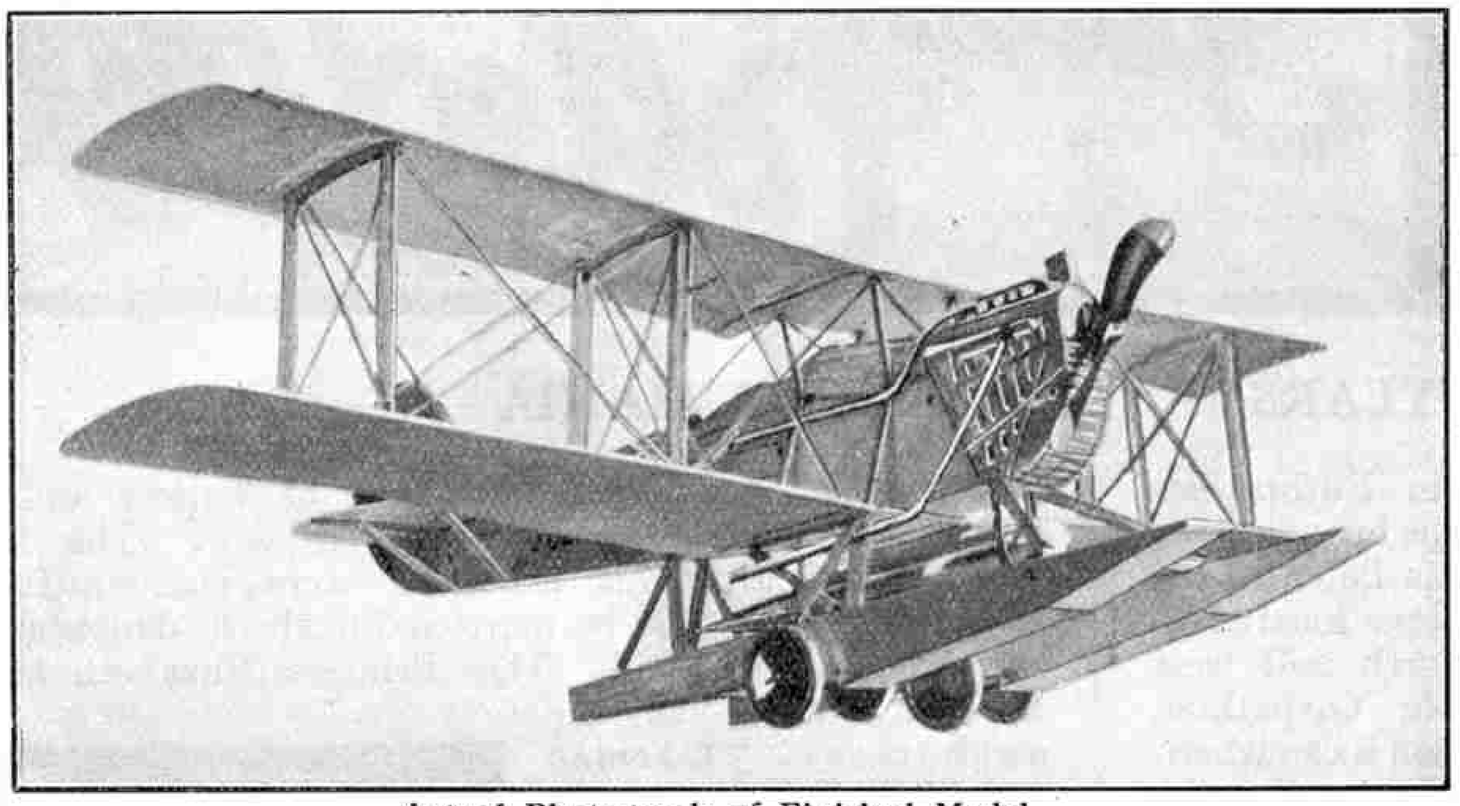
Prince Carol's first serious troubles began in 1875 when war between Russia and Turkey appeared imminent. He appealed to both powers for guarantees that Roumanian territorial rights would be observed in the event of war, but his appeals were ignored. In 1877 war broke out and Roumania, too weak to resist, was forced to grant free passage across her territory to the Russian army. The Turks, ignoring the fact that Roumania had been driven into this position against her will, declared the principality a rebel state and opened fire on some of the river towns, in particular on Kalafat. This was an opportunity to throw off the Turkish domination, and on 23rd May 1877, Roumania declared her independence.

Meanwhile the Russian armies were experiencing only a very small measure of success and after suffering two heavy defeats the Roumanians were asked for assistance. The principality thereupon decided to take an aggressive part in the fight against the Turks, and Prince Carol was given supreme control of the United Russian and Roumanian armies, the latter consisting of one division, 32,000 strong, in the great battle at Plevna.

The incidents leading up to the declaration of war are among the most decisive in the country's history and it is therefore fitting that they should be depicted in the stamps commemorating the reign in which they occurred. Thus the 5b. value depicts Prince Carol encouraging the defending troops at the town of Kalafat while the 25b. and 50b. values show respectively the Roumanian army crossing the Danube

(*Continued on page* 467)

ANOTHER FINE MODEL AEROPLANE



Actual Photograph of Finished Model

THE BLACKBURN "VELOS" TORPEDO SEAPLANE

By kind permission of the Blackburn Aeroplane Co. Ltd., we are able to supply parts for making a fine model of their "Velos" Torpedo Seaplane. It is a big model, being 24" span, 19" long and 8" high and has tinfoil engine cowling, torpedo, elastic motor inside fuselage, shock absorbers on the four aluminium wheels. These wheels are only fitted to the model to facilitate landing, as it is not advisable to fly the model over water. All necessary struts, bearings, propeller blank, wire spindles, elastic and coloured cardboard parts are included in the set which makes a model exactly as shown in the illustration.

Complete set of parts with illustrated book of instructions and working drawings, packed in an attractive box.

PRICE 3/6 POSTAGE FREE

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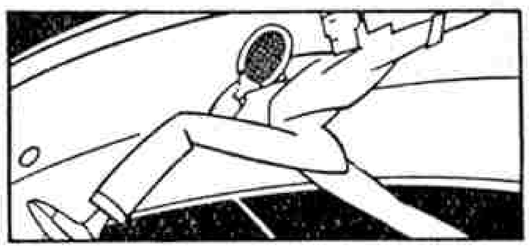
The Wee Bee I. 1/6, Post 4d.
Biplane 1/–, Post 4d.
Box of 8 Aeros, 3/6 Post Free.
Catalogue Free.



WILLIAM WAS FOND OF SPEED

William was speedy in everything he did—even to the way he rushed to the office in the morning! He played left wing at football. He sped along the highway on a motor cycle. He had a service at tennis that went like a flash of lightning.

William used a camera, and living up to his reputation he always tried to take snaps of rapidly-moving objects. But somehow the pictures never materialized—the action apparently was much too rapid for the film.

Then one day he tried Ilford Roll Film. Without realizing it, he was now using the fastest Roll Film in the world. All he did know was that it gave him excellent pictures for ever after; and he's the complete "speed merchant" once again!

The Film that never disappoints!

ILFORD ROLL FILM

The British Made Film in the Red Carton.
In sizes to fit all roll-film cameras.

From Photographic Dealers Everywhere.

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MODEL RACING YACHTS

These Yachts are too well known to require any recommendation. Carved from noted lines and beautifully finished, rigged with brass fittings, complete with lead keel, rudder, etc.

Guaranteed fast racers whether in a pond or the open sea.

Lengths of Deck: 16", 9/3; 18", 11/9; 21", 16/9; 24", 22/3 carr. free.

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MODEL SHIPS' FITTINGS

Blocks, Bowsies, Propellers and all Model Yacht Fittings.

Steam, Clockwork and Electric Motor Boats and Hulls

New Reversing Electric Boat Motors, Accumulators, Clockwork Boat Motors, etc., etc.

Send to-day for our New Catalogues just published, viz.:

Yacht and Ships' Fittings Catalogue, 2d. post free.

Art Coloured Catalogue of Motor Cruisers, etc., together with Yacht and Ships' Fittings Catalogue, 6d. post free.

Clyde Model Dockyard

Established 1789. Argyle Arcade, GLASGOW

Model Makers to the Admiralty.

(*Continued from page* 465)

on its way to take part in the siege of Plevna, and Prince Carol at the head of his army on the march to this battle.

The siege of Plevna stands out in Roumanian history. The fight was long and the struggle intense, but the Roumanian troops displayed throughout a fortitude and courage worthy of old campaigners. The successful assault on the Grivitza redoubt—believed to be impregnable—was undoubtedly the turning point of the war and, shortly after, Prince Carol returned in triumph to Bucharest at the head of the victorious troops. The return of the Roumanian army with the Prince at the head of the column is shown on the 40b. issue.

The peace conference of San Stefano followed in 1878 but Roumania, despite her great part in the war, was not allowed to be represented, being still an unrecognised state. At this congress was seen the remarkable spectacle of Russia presenting a claim against her ally for the restoration of the three Southern Provinces of Bessarabia that had been ceded to Roumania at the Paris Conference following the defeat of Russia in the Crimean War. The Russian claim was successful and in exchange Roumania was granted the useless Black Sea State, Dobrudja, and the islands of the Danubian delta. At this conference the independence of Roumania was formally acknowledged, but the principality was far from satisfied at the outcome of the conference and appealed, without success, to the Berlin Congress of 1879 for a re-adjustment of her wrongs.

In the meantime, and even so far back as 1871, there had been a steadily growing feeling of irritation against the increasing attempts of Russia to hinder the development of Roumania. Then came the events leading up to the Russo-Turkish war and the subsequent treaty of San Stefano which, of course, tended still further to divert Roumanian public opinion against Russia. There existed however a strong pro-Russian party which, to counter the anti-Russian influence, endeavoured to foster ill-feeling against Germany on the score of the failure of the appeal to the Berlin Congress; but despite this propaganda, the friendship, political and social, with Germany and the Central Powers became stronger. The anti-German party were, however, not without hope of disrupting the Teutonic influence that obviously was playing a large part in the shaping of the country's future. The assassination of Czar Alexander II. of Russia provided the awaited opportunity and immediately a loud outcry was raised against the existing Government, which was accused of republican tendencies.

The Government reply was a brilliant political stroke. On the 26th March, 1881, Prince Carol was proclaimed King of Roumania, and on 22nd May, of the same year, his coronation took place, the crown placed on his head being of metal taken from the captured guns of the Plevna redoubt.

The elevation of Carol did much to remove the bitterness of the internal divisions and despite three separate uprisings of the peasantry, in 1888, 1894 and 1900, the years following his coronation were marked by comparative tranquility and steady progress. King Carol of Roumania died in 1914, but he had lived to raise his country from two small unrecognised provinces into the first of the Balkan powers and seventh in rank among the independent states of Europe.

There remain five stamps of the issue to which reference has not been made. These are largely illustrative of the social and religious development of the country during the last quarter of the 19th century. The 1L. stamp illustrates the brilliant scene at the opening of the new cathedral at Curtea de Arges in 1896. The building of this great structure was an enterprise to which the King devoted a considerable interest. The 2L. stamp, showing King Carol at the shrine of St. Nicholas in 1904, is a further pointer to the religious influence that played a great part in the guiding of the King's policy in international matters. The 3b. and 10b. values depict domestic incidents of smaller importance, the former showing the King out driving in his royal coach and the latter a meeting between the King and Osman Pasha. The 15b. value shows two portraits of Carol, first as a young man at the time of his coming to Roumania in 1866 and then as King forty years later.

That the King placed too great a faith in Teutonic measures of development may perhaps be true, but nevertheless the greatest tribute to the general wisdom of his ruling lies in the great leap forward in the national prosperity during the last quarter of the 19th century. So marked was the country's progress, so great the vigour and mental improvement of her people, so triumphant the success of Roumanian arms in the Russo-Turkish war, that the fitting culmination was the coronation of Carol, whose untiring energy paved the way.

During the recent Great War, Roumania fought side by side with Britain and again her territory was the scene of many battles. Much valuable property had to be destroyed to prevent its capture by the enemy and included among this were the great Roumanian oil wells, the source of much of the country's pre-war prosperity. The loss of this source of national income has proved a great disaster from which the country even now is only just beginning to recover.

Roumania had another very unfortunate experience during the war but this had at least the saving grace of an ironic touch. The Roumanian Crown Jewels and reserves of gold were sent to Russia for safe keeping as the war was developing on Roumanian soil. The coming of the Bolshevist régime witnessed the disappearance of the Russian Crown Jewels. And with them, one presumes, went the Roumanian Jewels and gold, for the Bolsheviks have declined to restore them to their rightful owners!

We take this opportunity of making acknowledgment to Stanley Gibbons Ltd., for their courtesy in loaning the stamps from which the illustrations used with this article have been prepared.

Stamp Gossip

On this page month by month we propose to deal with matters of general interest to stamp collectors in addition to the usual new issue notes. It is intended also to answer queries of general interest here.

Readers, particularly those resident outside Great Britain, can help to make this column of great use to their fellow collectors by sending along any items of general interest that they may discover. Notes on and specimens of new issues and overprints will be welcomed and such specimens will either be returned or their face value credited, as the senders wish.

* * * *

Turkish Stamp to be Withdrawn

We understand from E. Whitaker, of Constantinople, that the 2½ piastre stamp of the current pictorial series is shortly to be withdrawn from use. This stamp depicts the Gorge of Sakaria and is coloured slate-black. It is intended to increase the foreign postal rate from Turkey to 12½ piastres and presumably a new stamp showing that value will be issued.

* * * *

Brazilian Centenary

A special issue commemorating the Centenary of the establishment of the Brazilian Courts of Justice is to be made in the next few months, probably in August.

* * * *

King Charles I. on Stamp

Postage stamps were unknown in the days of "Good King Charles" but nevertheless this famous member of the House of Stuart has been posthumously honoured by the appearance of his portrait, side by side with that of our present King, on the new Barbados tercentenary issue. This is the first appearance of King Charles I. on a stamp and his connection with a Barbados issue nearly three hundred years after his death, may at first seem obscure. Actually, however, there is a close connection for it was to Barbados that Cromwell sent his "Royalist" adversaries as they were captured in the Civil War. Doubtless many of the white inhabitants of Barbados to-day can trace their line of descent from Cromwell's exported prisoners.

GAMAGES

Still Supplying Britain's Youth!

THE "EZYRIG" MODEL SAILING YACHT
(British Made)
A real Racing Craft, made of first-class Yellow Pine and Honduras Mahogany. Guaranteed to sail.

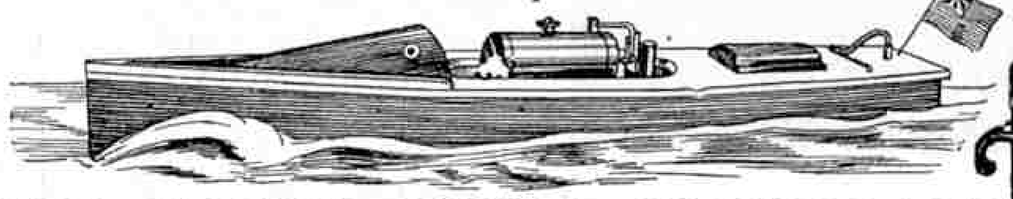
WRITE FOR LIST

Fitted with the new 'Ezyrig' by means of which they may be instantaneously rigged.

Varnished Series.—Hollow, 12 in. long, **4/6**, Post 6d. Hollow, 14 in. long, **6/9**, Post 6d. Hollow, 16 in. long, **9/11**, Post 6d. Hollow, 18 in. long, **14/6**, Post 6d. Hollow, Lined Deck, 21 in. long, **19/6**, Post 6d. Hollow, Lined Deck, Topsails, 24 in. long, **27/6**, Post free. Hollow, Topsails and Jib, 27 in. long. **47/6**, Post free.

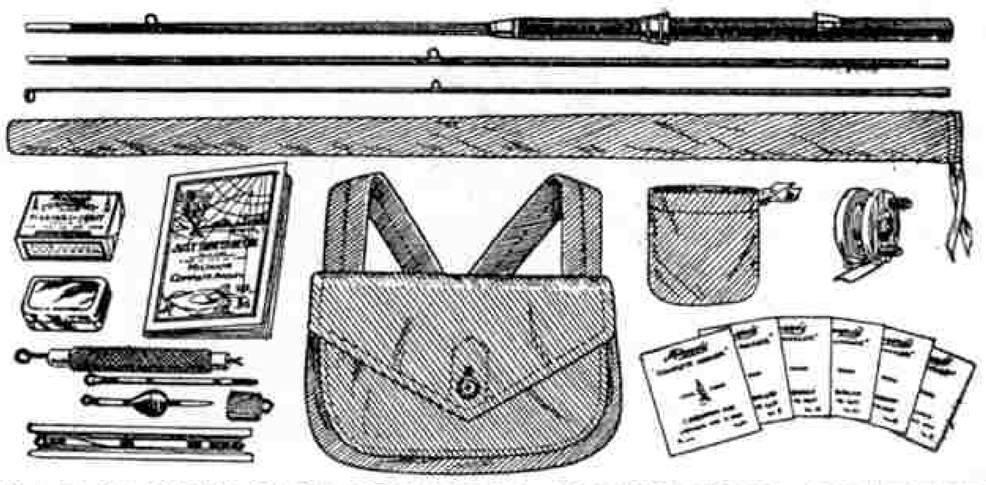
MAY—and the arrival of SUMMER

Gamages are ready with Cameras, Bicycles, Motor Cycles, Camping Needs, etc. We will see that Meccano Boys miss none of the Joys of an open-air Summer. If you cannot call at Holborn, write (mentioning "Meccano Mag.") and tell us about your Hobbies, and we will send you a Catalogue about them—quite free!



THE FAMOUS MOTOR HYDROPLANE "MAPLE LEAF V."

The Hull is constructed of selected Yellow Pine and has mahogany spray hood and deck fittings, brass rudder, tiller and rack, and strong wire guard to protect the brass propeller. Enamelled in a beautiful shade of green, the hood, deck and fittings being varnished. 26 ins. long. Fitted steam engine and boiler. "Maple Leaf V." will run for 30 minutes and cover a long distance. Price **22/6**
These have proved to be a very popular Type of Model for which we have had an enormous demand (one of the many selected from our Splendid Displays in our Model Show Rooms).



GAMAGES COMPLETE ANGLER'S OUTFIT

Fishing's a splendid sport. Start this year with the set illustrated above. Complete in box. Each box contains 8 ft. 3 joint rod with rings and reel fittings. Reel, Lines, Floats. Gut Casts, Ledger, 7 Hooks to Gut. Plummet, Split Shot, Disgorger, Haversack, Worm Bag, Bait, and Book on "How to Begin." Price complete **21/-**

Take up Photography

It is interesting and can be a really cheap Hobby if you use the

LITTLE NIPPER CAMERA

now offered at HALF PRICE

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Here is the Little Nipper Camera, as illustrated. Capable of taking beautiful little pictures, the making of which is very easy and a most exciting hobby. With it you will be able to make pictures of all your friends so easily that the Little Nipper will become your constant companion everywhere.
Complete in box with 1 plate-holder and 20-page Instruction Book.
Size of Picture—2 5/16 × 1¾ (4½ × 6 c.m.)

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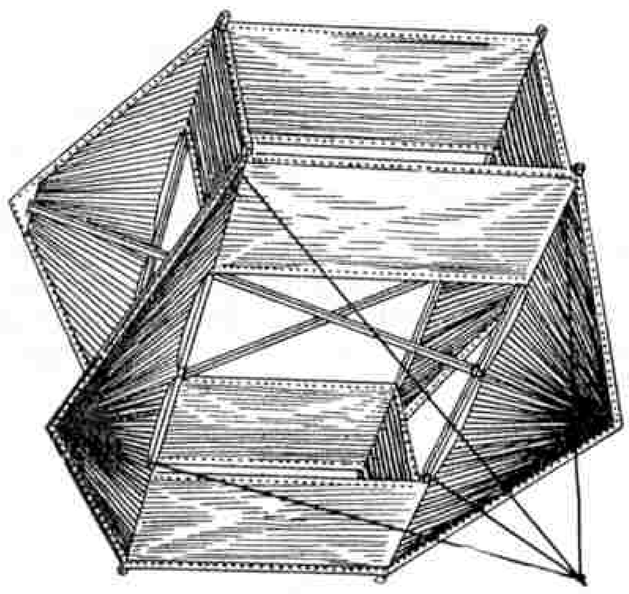


THE QUADROPLANE

The finest of all Kites for attaining great heights. It is well and strongly made and stands 29" high. Post 6d. Price **3/6**

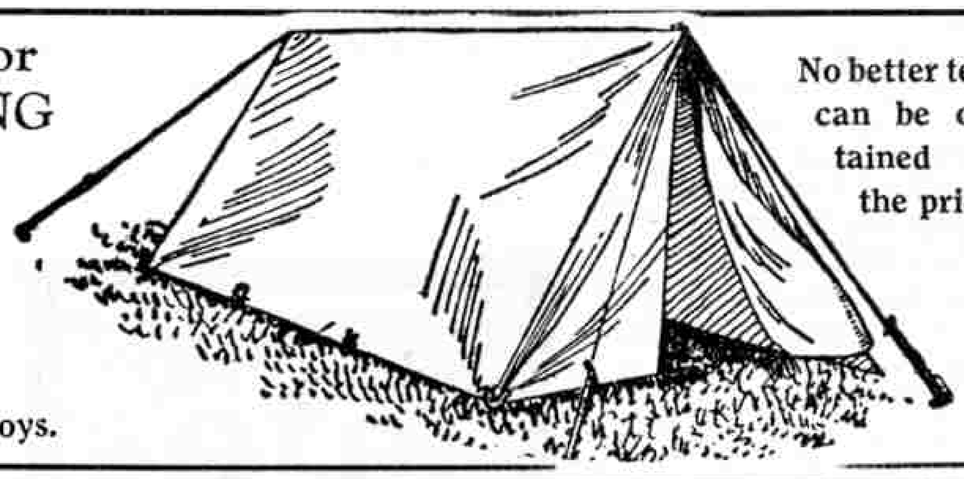
32" high...Price **4/6**
35" high...Price **5/11**
Post 6d.

38" high
Price **7/6**
Post free.

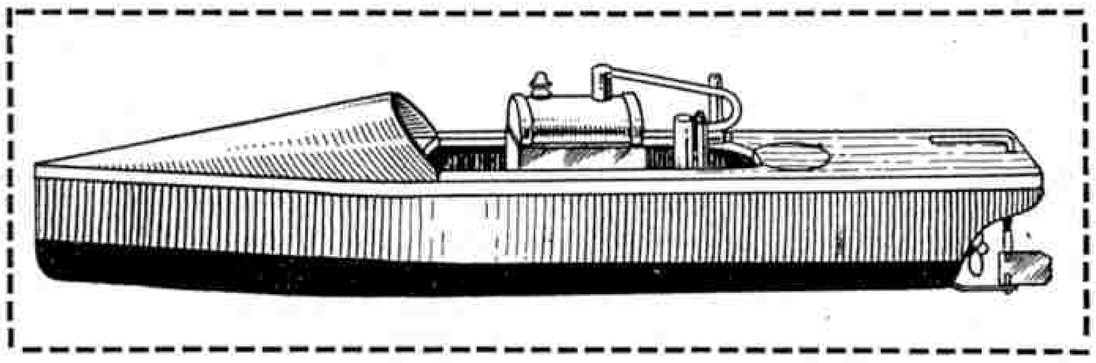
Spend a week-end or HOLIDAY CAMPING

and you can't do better than to get this Tent. Made of Green Rotproof Special Lightweight Material, absolutely waterproof, Jointed Poles. Packed complete in valise including ropes, pegs, mallet, etc.
Size 6 × 5 × 4 Price **30/-**

Will sleep 2 adults or 3 to 4 boys.



No better tent can be obtained at the price.



Boys! Get This Splendid Racing Launch "Miss AMERICA"

A splendid boat of improved design and speed. It is beautifully shaped, with a hull finished in two colours and the deck lined for planking. The engine unit is of improved pattern with lamp that raises a big head of steam in a very few minutes. A new automatic greaser is fitted as a lubricator, and gives greatly increased speed. 22½ ins. long. 4⅛ ins. beam. Price **12/6**
A non-spill lamp, filler and full instructions are sent with the boat in a strong cardboard box.

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Lives of Inventors—

(*Continued from page* 417)

bridge over the Clyde at Hamilton was designed by Watt in 1770 and subsequently built. For this commission he had stipulated beforehand for a fee of seven guineas and he secured the commission in preference to Smeaton who required £10 to do it!

In 1772 operations on the Monkland Canal came to a standstill owing to the exhaustion of funds. It was found impossible to raise sufficient money to carry the work through to completion, and in consequence Watt's appointment lapsed. Instinctively the inventor reverted to the matter of the steam engine and renewed his efforts to effect a partnership between his Birmingham friends and Roebuck and himself. Boulton and Small proved diffident, however, and would not consent until the trial engine at Soho should be erected and its worth established.

Roebuck's Bankruptcy

Not long after Watt received this cautious reply from Soho a dramatic turn was given to events by the bankruptcy of Roebuck. His debt to Boulton amounted to £1,200, but rather than take legal proceedings against his friend, Boulton agreed to accept as payment the former's two-thirds share in the engine patent. This course was very agreeable to Roebuck's creditors, who frankly regarded the patent as worthless! Thus the transfer was effected and Roebuck's part in helping forward the work of perfecting the steam engine was brought to a close. Arrangements were next made to dismantle the trial engine then still standing in the Kinneil outhouse. The ironwork, pump and cylinder were carefully packed and shipped to London, from where they were conveyed to Boulton at Birmingham.

At the time these far-reaching events were taking place, in the spring of 1773, Watt was engaged on a survey for the Caledonian Canal, and it was not until a year later that he completed all his commissions. The year's work brought him £200 and this he generously shared with his late partner.

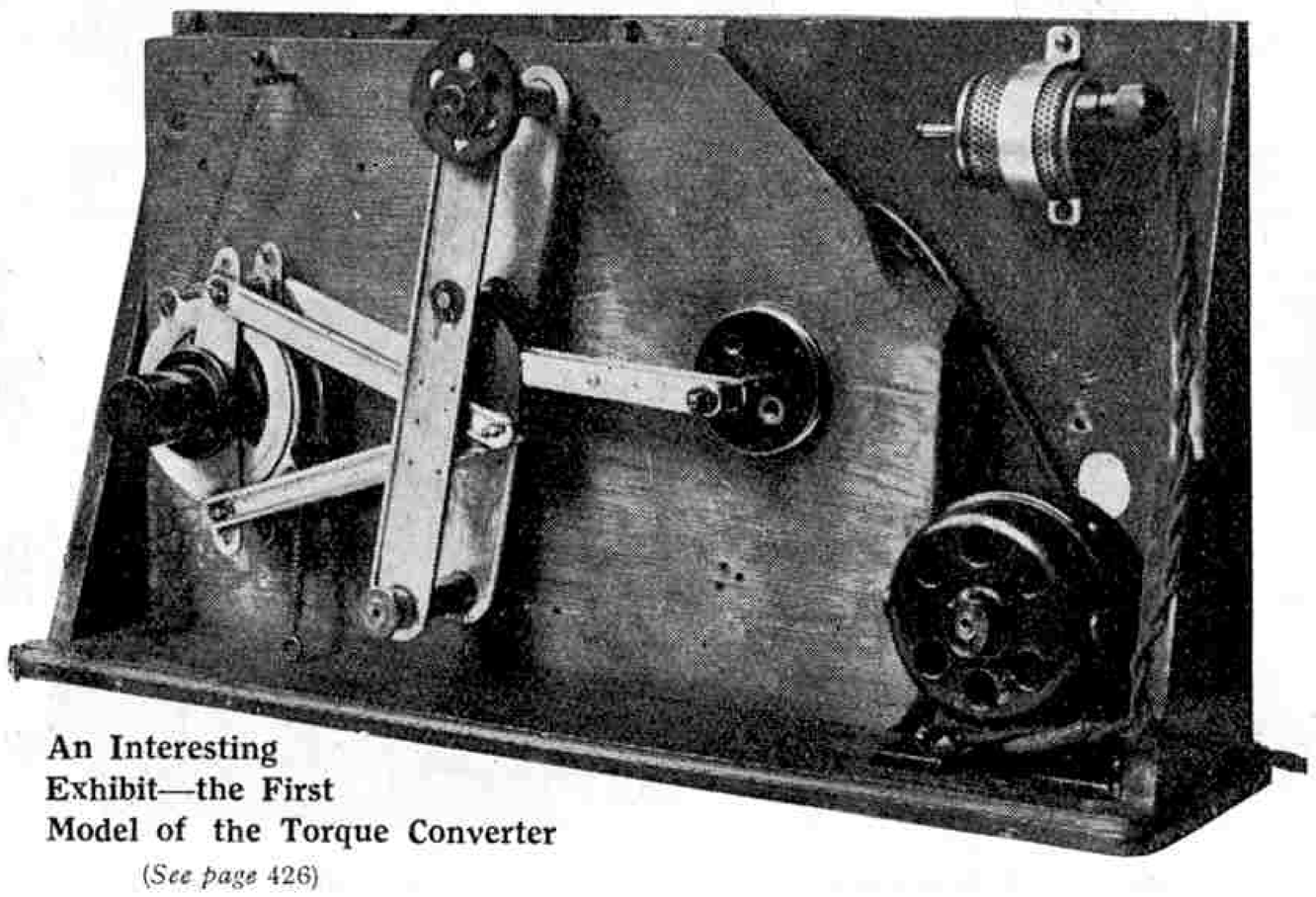
Association with Boulton Commences

Boulton was widely known as an enterprising and practical man and when it became known that he had taken up the patent of a new steam pumping engine, enquiries soon began to reach the Soho Works. On every hand the Newcomen engine was proving incapable of dealing with floods in deep workings. In Cornwall, especially, its heavy consumption of coal had long made it unpopular, but it had represented the best thing so far available. Now, however, there were rumours of something better.

Small wrote urging Watt to conclude his affairs in Scotland speedily and remove to Birmingham to perfect the trial engine and superintend the manufacture of engines to order. "A friend of Boulton's in Cornwall," said Small, "sent us word a few days ago that four or five copper mines are just going to be abandoned because of the high price of coals, and begs us to apply to them instantly. The Yorks Buildings Company delay rebuilding their engine, with great inconvenience to themselves, waiting for yours. Yesterday application was made to me by a Mining Company in Derbyshire to know when you are to be in England about the engines, because they must quit their mine if you cannot relieve them."

While yet in Scotland Watt suffered a further loss by the death of his wife and it was with few regrets that he at length left Glasgow for Birmingham and bade farewell to the scene of his misfortunes. The tide of events was now about to turn in his favour, and his arrival at Soho in May 1774 marked the active beginning of an association destined to continue for more than a quarter of a century and to blossom into fame and prosperity.

An Interesting Model



An Interesting Exhibit—the First Model of the Torque Converter

(*See page* 426)

Eclipse of the Sun—(*continued from page* 391)

These men had been blindfolded for 10 minutes before totality so that their eyes responded immediately and accurately to the colour of the comparatively feeble light of the corona. At the time of this eclipse the spots on the Sun were numerous. It was expected, therefore, that the corona would not be very brilliant and that the streamers would be restricted to the equatorial regions of the Sun. This proved to be the case.

The chief instruments used at this eclipse were the prismatic cameras. It has already been mentioned that Sir Norman was particularly interested in spectroscopic work. He wished to secure good photographs of the prominences, and also of the corona, in light of various colours, as thereby he hoped not only to obtain information regarding their compositions, but also to find the heights above the Sun's surface at which the various gases are to be found. Instead, therefore, of using telescopes and cameras in the ordinary way to secure photographs in the general light, prisms were placed in front to spread out the image on the plates of the camera into a spectrum of such images. Dr. W. J. S. Lockyer and Professor A. Fowler were the astronomers who were in charge of each of these instruments and they had sailors to help them in the mechanical work of changing plates.

Other parties of naval officers and men made observations of such phenomena as the shadow bands, which were very prominent on this occasion, and of the stars. For some time prior to the eclipse those in charge of the latter task had spent several hours each night in mapping the stars and estimating their magnitude, so that a good record of the stars visible was obtained. The curious observation was made that more stars were visible just before totality than during the time that the Sun was completely obscured. In addition still other members of the crew of the "*Melpomene*" were busily engaged in taking photographs of the landscape with ordinary cameras.

It will be seen that Sir Norman was able to carry through a large programme, and the results that he obtained have assisted greatly to increase our knowledge of the chromosphere and the corona. One particular feature of his organisation that should be mentioned was that a period was allowed to each man during which he could observe the eclipse for himself. On a previous occasion the volunteer who acted as time-keeper had been so intent on carrying out his duties that he deliberately turned his back to the Sun so that he would not be distracted by the temptation to watch the unique event in the heavens. After this episode Sir Norman always took care to have at least two men for every task. Two time-keepers were always appointed, for instance, each of them carrying out the necessary duties for one half of the period of totality.

In next month's article practical advice on seeing and photographing the eclipse will be given, together with an account of the most important eclipse expedition ever undertaken.

To Manchester Readers

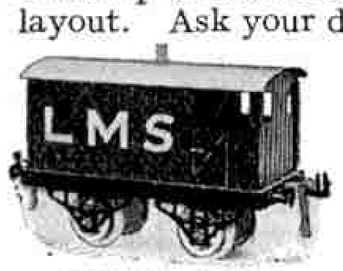
Some time ago a reader in Manchester sent us particulars of his son's model railway, together with a blue print showing the layout. We were particularly interested in the scheme outlined, whereby the railway was a "Limited Company," the shareholders being relatives and friends. We have unfortunately mislaid our correspondent's letter and we shall be greatly obliged if he will communicate with us.

ROLLING STOCK AND ACCESSORIES

Hornby Series — Gauge 0

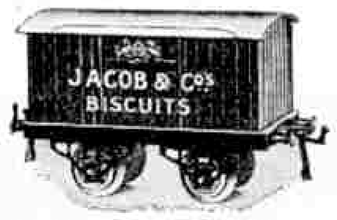
There are now over 60 different train accessories—Stations, Signal-boxes, Lamps, Wagons, Level-Crossings, Foot-Bridges, Turntables, etc. Further accessories will be added to the system from time to time, and will be announced in the pages of the "*M.M.*"

All Hornby Rolling Stock and Accessories are built in correct proportion to the size, gauge, method of coupling, etc., of the Hornby Trains and all have the uniformly beautiful finish that is the great feature of these trains. With these accessories you can build up a most realistic railway system, and the splendid range of rails, points, and crossings make possible endless variety in rail layout. Ask your dealer to show you specimens of the new products that have recently been introduced.

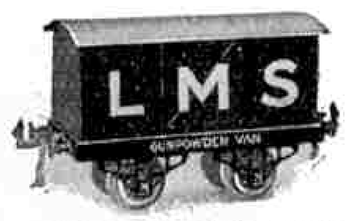


BRAKE VAN
Finished in grey, with opening doors. Price **4/–**

***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans. Price **4/6**

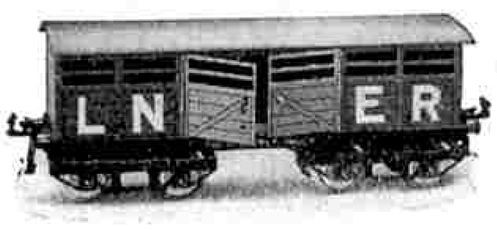


JACOB'S BISCUIT VAN
Finished in crimson lake, with opening doors. Price **4/–**

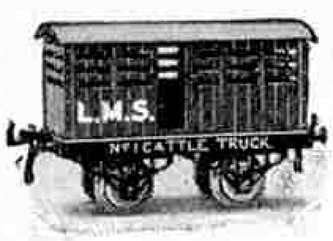


***GUNPOWDER VAN**
Finished in red, with opening doors. Price **4/–**

BRAKE VAN
Finished in grey, with opening doors. Price **4/–**



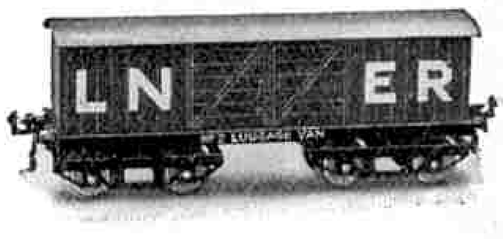
***No. 2 CATTLE TRUCK**
Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **6/6**



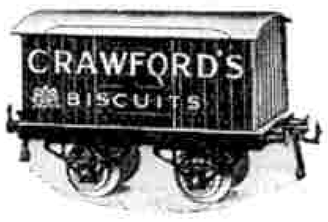
***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design. Price **4/–**

SIDE TIPPING WAGON
Excellent design and finish. Price **3/6**

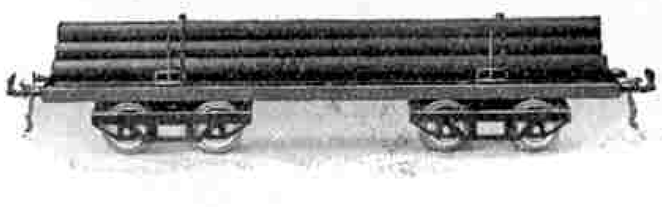
CARR'S BISCUIT VAN
Finished in dark blue, with opening doors. Price **4/–**



***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **6/6**



CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors ... Price **4/–**



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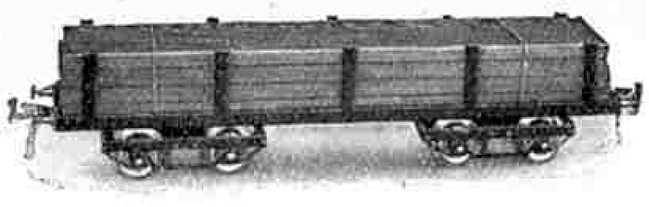
Fitted with bolsters and stanchions for log transport Suitable for 2-ft. radius rails only. Price **5/–**



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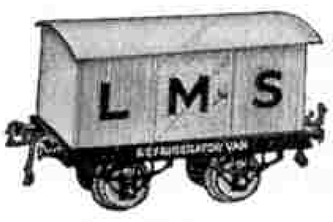
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price **4/6**



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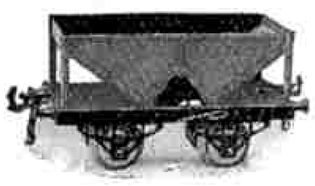

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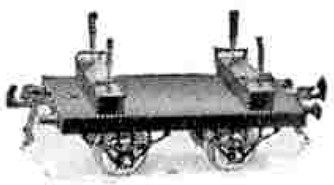

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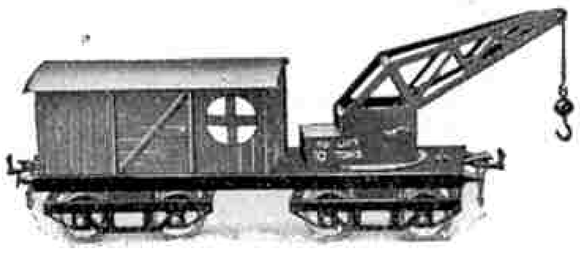

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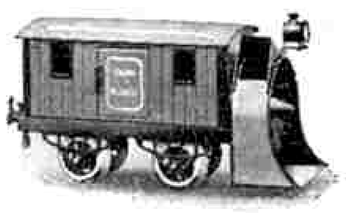

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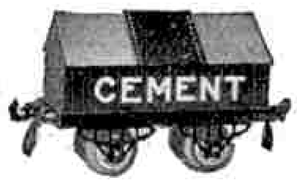

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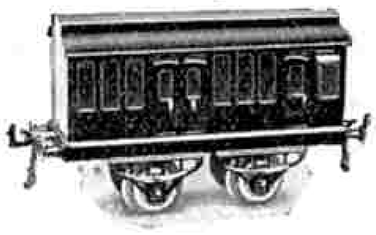

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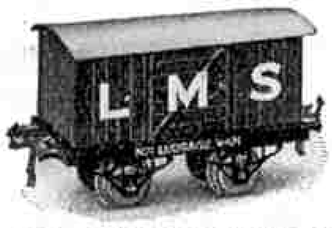

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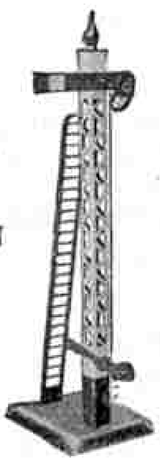

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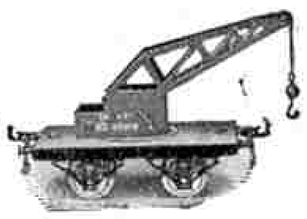

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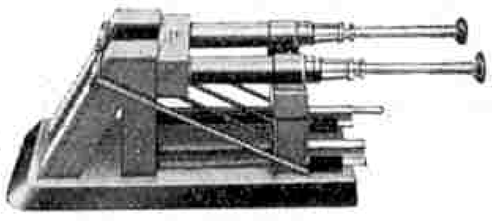

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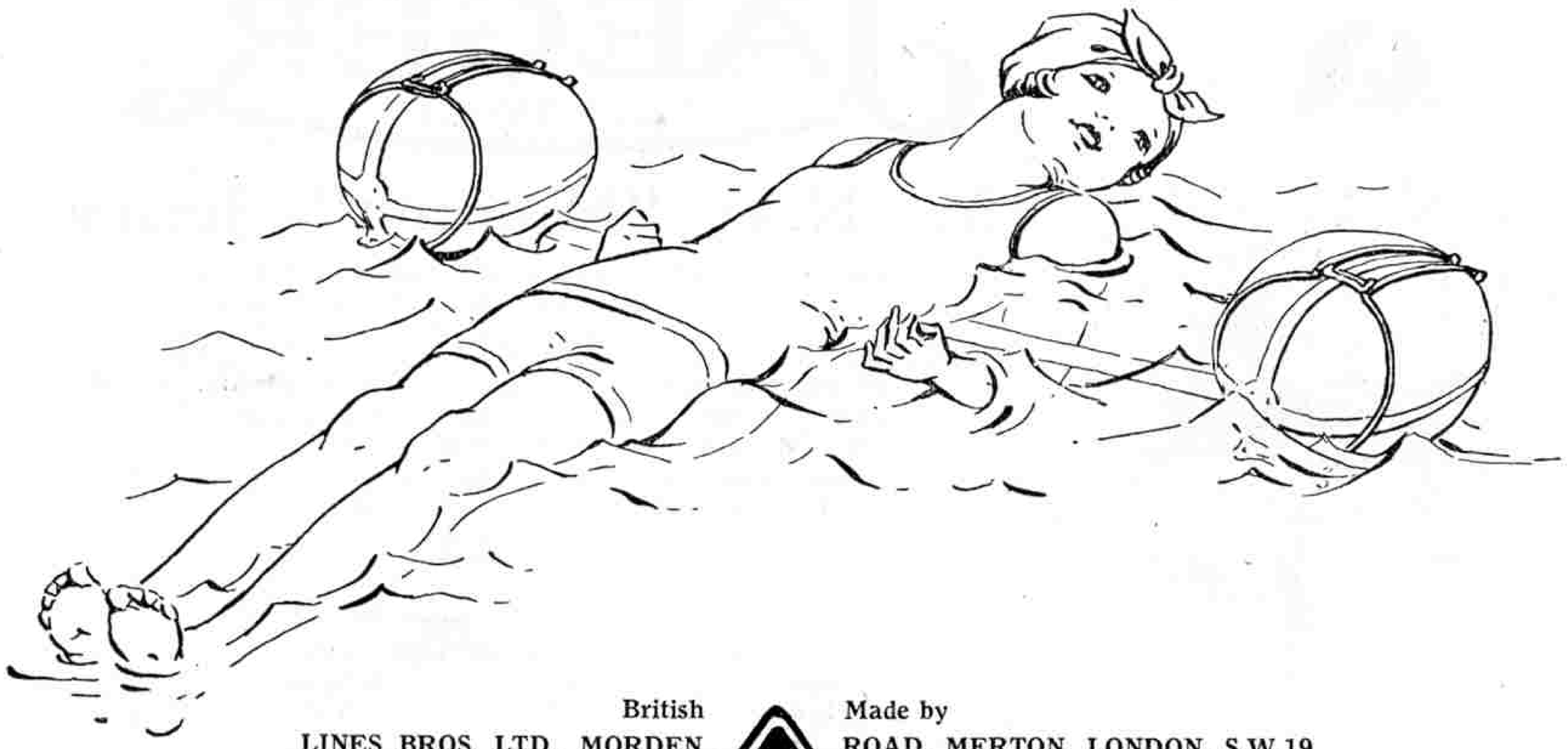

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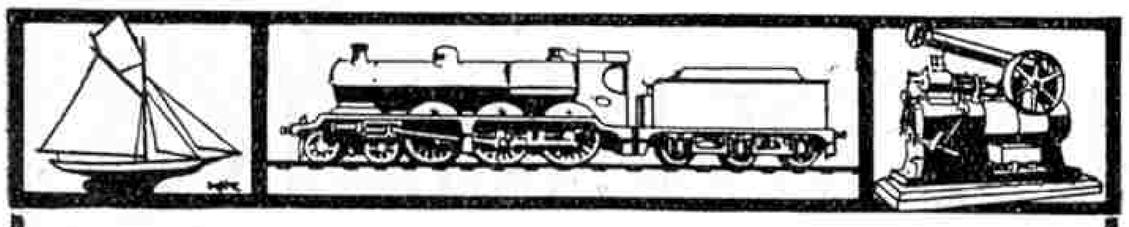

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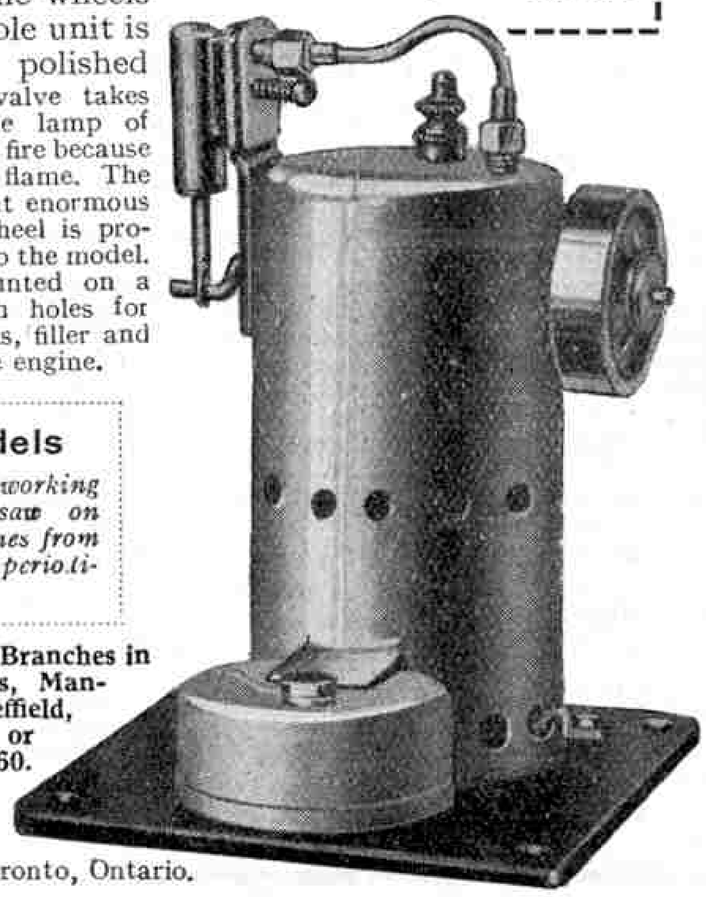

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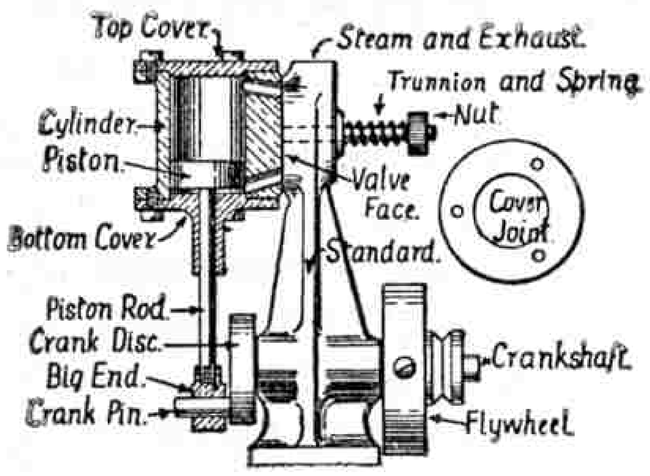

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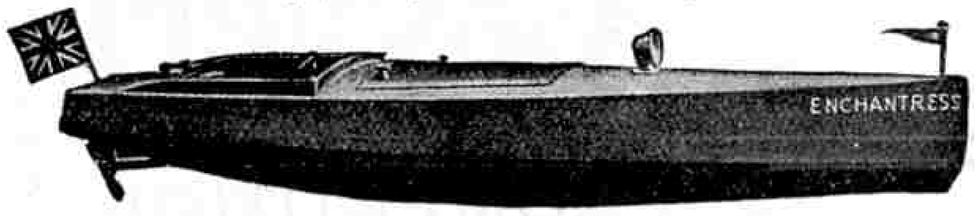

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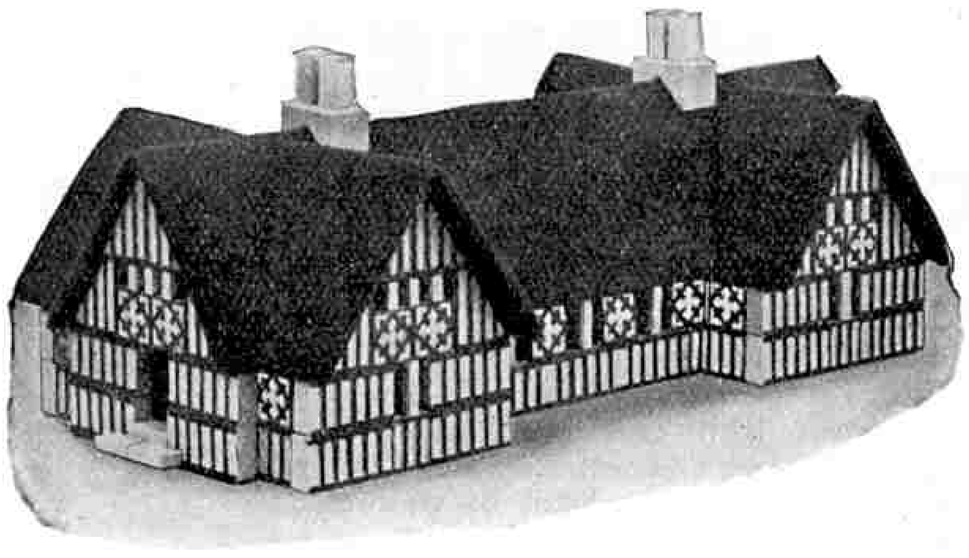

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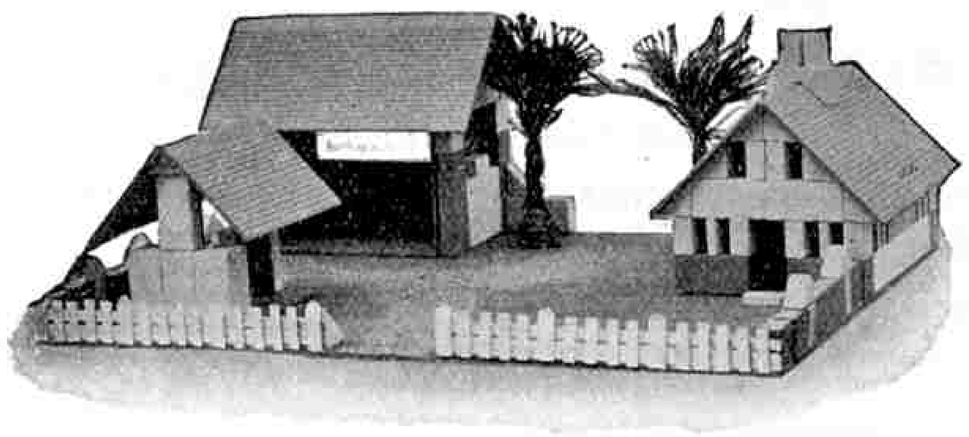

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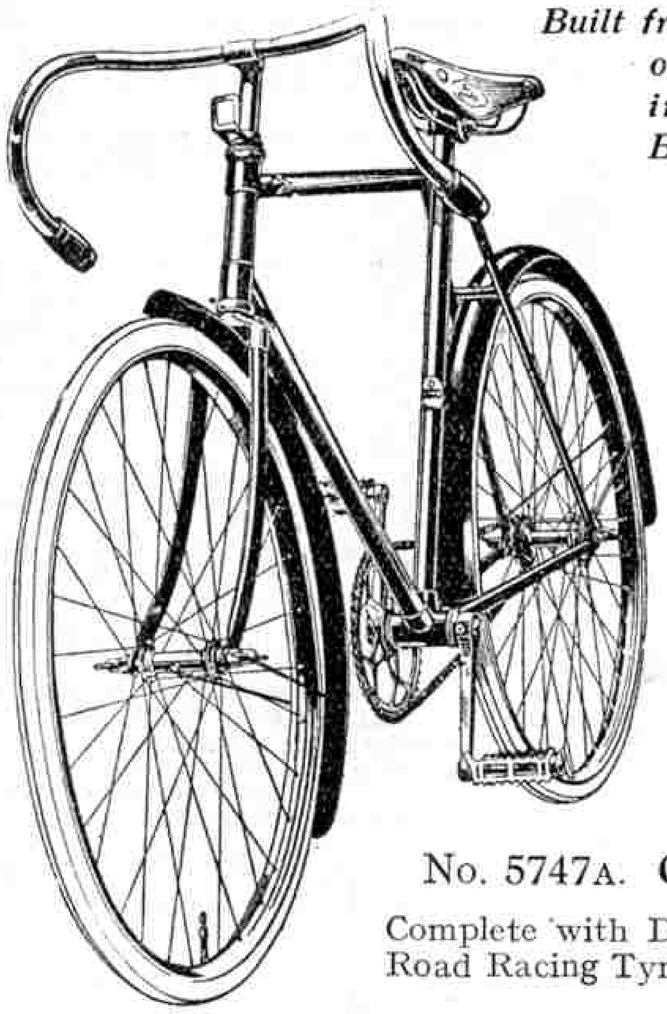

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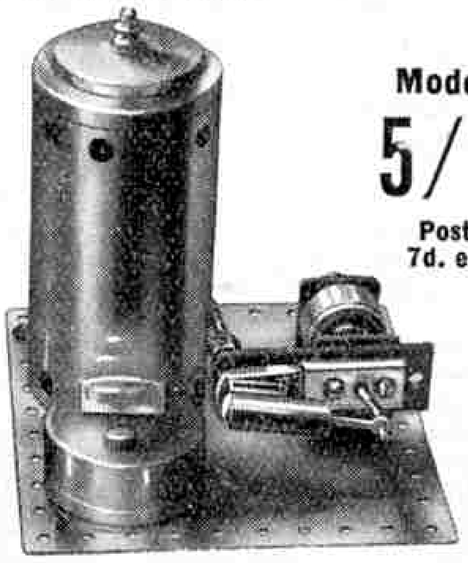

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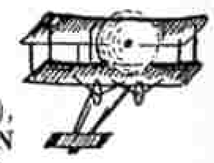

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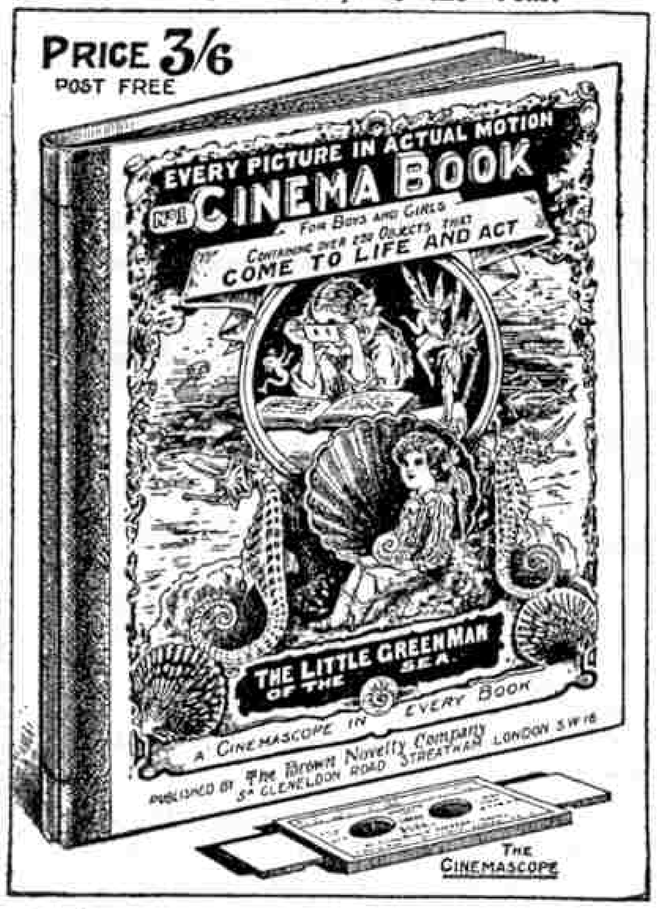

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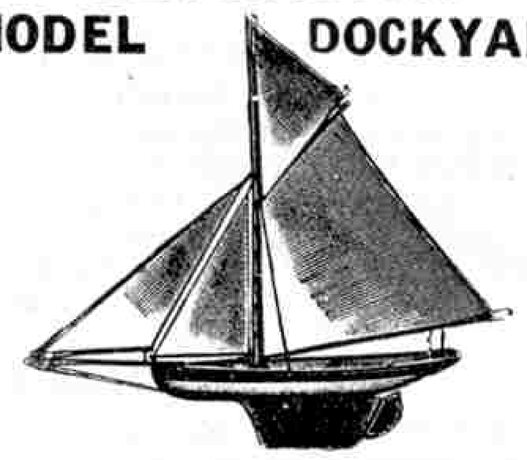

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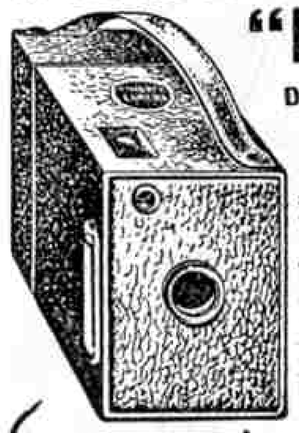

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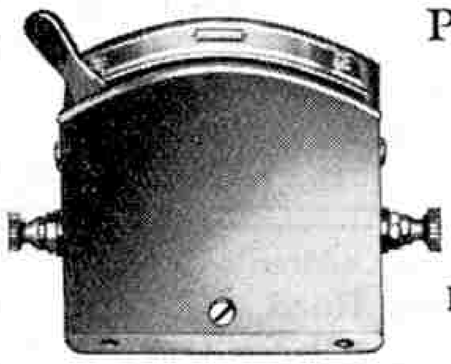

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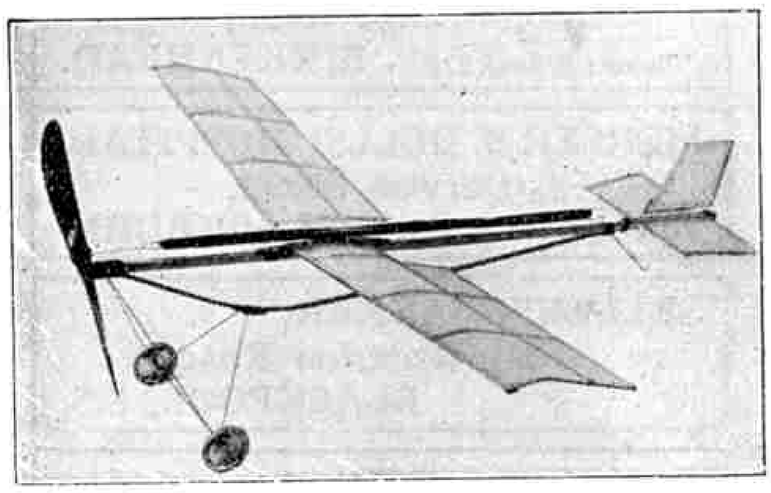

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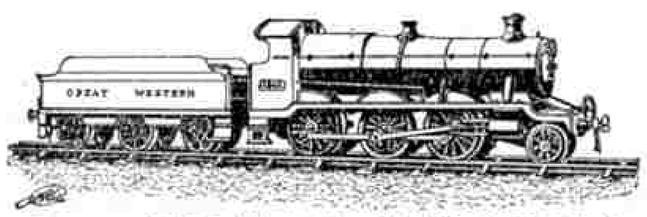

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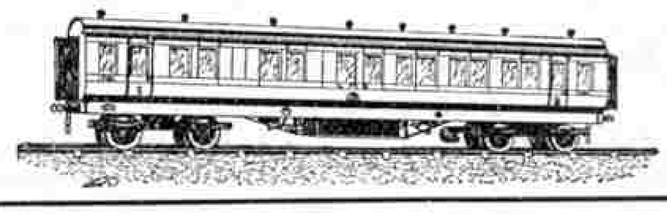

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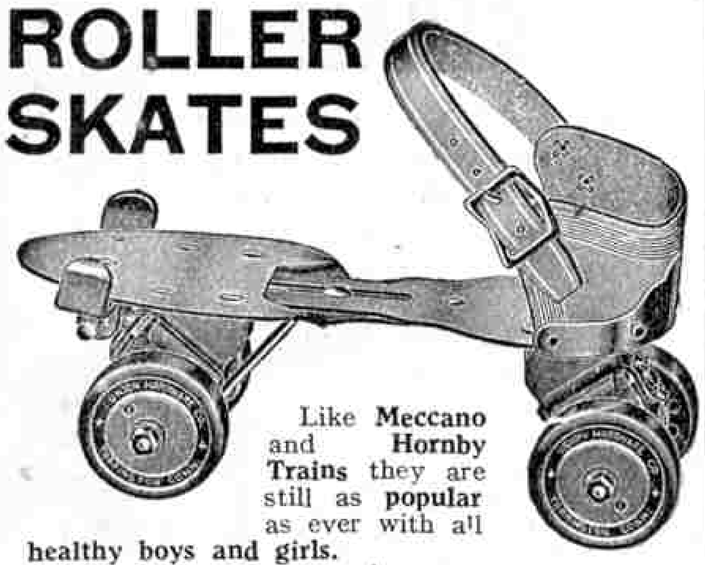

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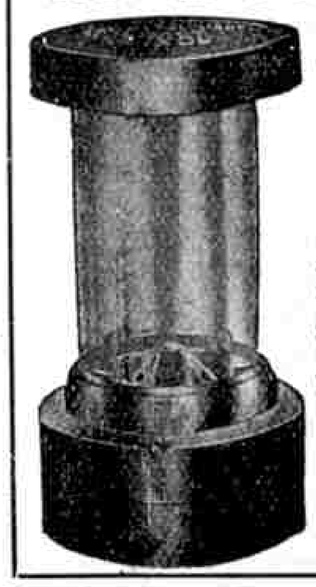

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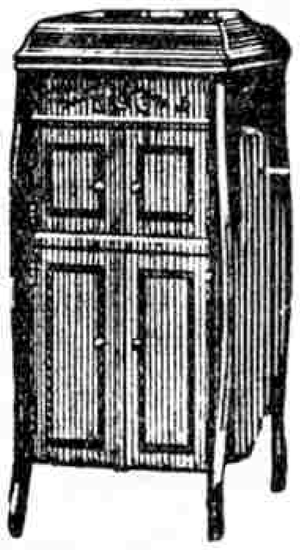

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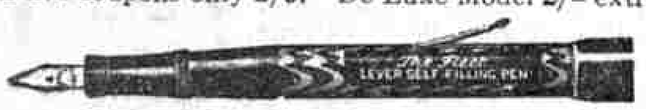

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BINNS ROAD, LIVERPOOL.
Telegrams: "Meccano, Liverpool."

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To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (*i.e.*, not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order.

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Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

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Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office, the price and subscription rates being as above.

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Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

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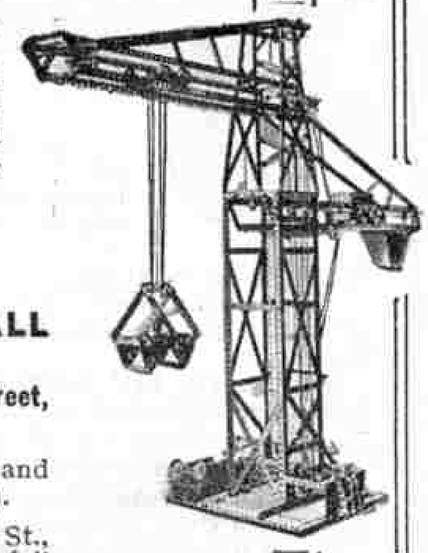

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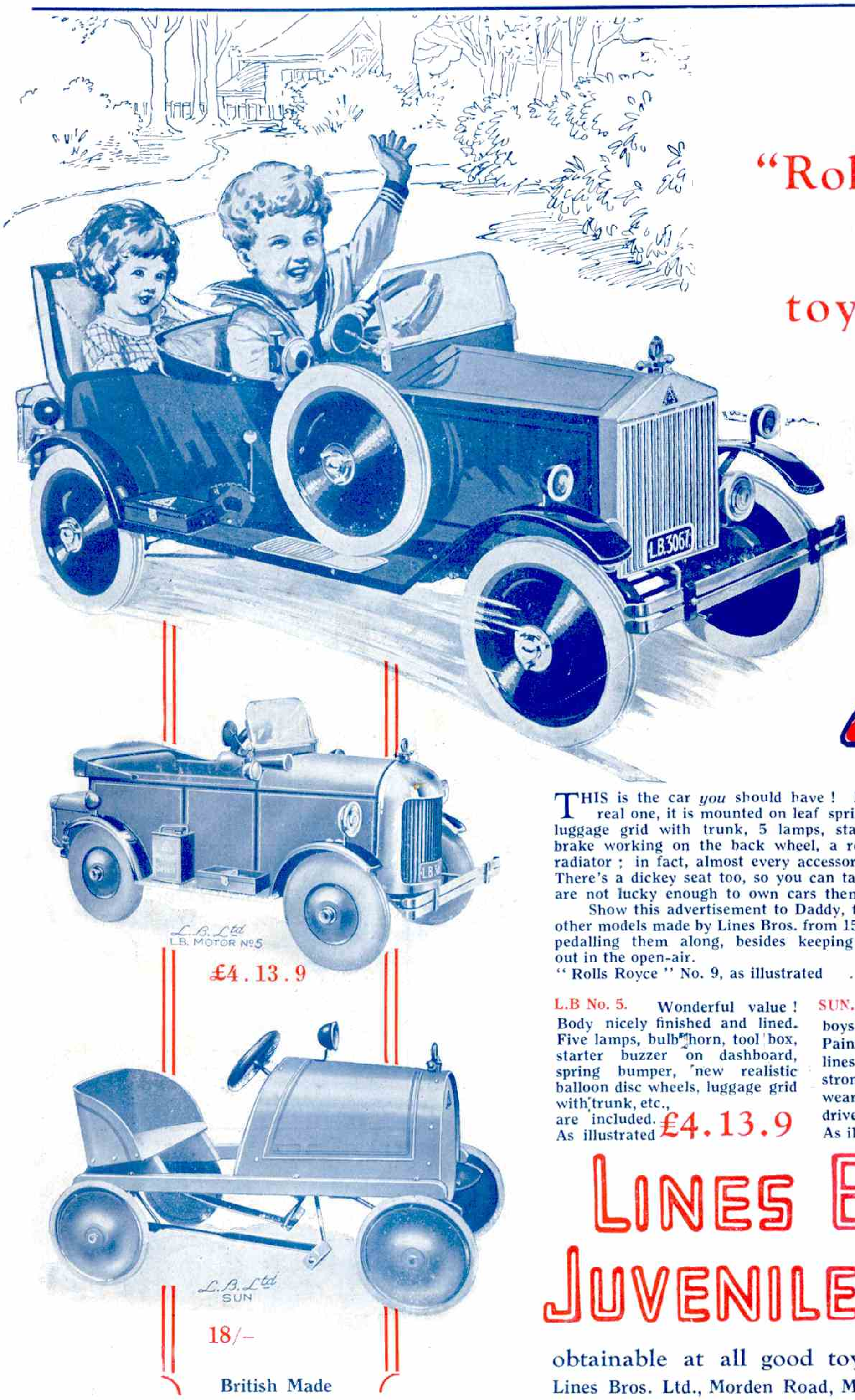

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